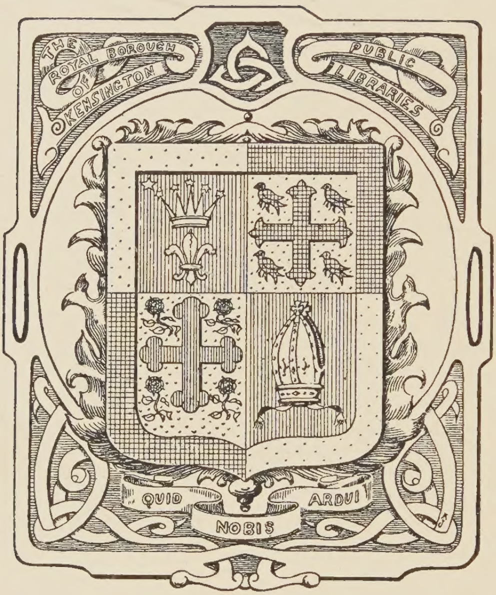
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INTERNATIONAL GEOGRAPHICAL CONGRESS

CAMBRIDGE

1928

PRINTED IN GREAT BRITAIN

PREFACE

THE organization of the Congress was entrusted by the British National Committee for Geography to an Executive Committee, the composition of which is given on p. 1. The Executive Committee, which was responsible for the editing of this Report, handed over the detailed sub-editing to Mr J. H. Reynolds and the Rev. A. J. Potter.

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MAPS AND DIAGRAMS

PAST INTERNATIONAL GEOGRAPHICAL CONGRESSES

See *International Geographical Congresses: A brief account of their origin, history, and proceedings, from the Address delivered at the Anniversary General Meeting of the Royal Geographical Society in June* 1928, *by the President* Colonel Sir Charles Close, K.B.E., C.B., C.M.G., F.R.S. (*Geographical Journal*, August 1928, LXXII, pp. 100–116.) Presented to the Congress.

Anvers	1871	Berlin	1899
Paris	1875	United States	1904
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REGULATIONS FOR INTERNATIONAL GEOGRAPHICAL CONGRESSES

The General Assembly of the International Geographical Union of April 1924 drew up certain Regulations for the conduct of International Geographical Congresses, which are here reprinted.

REGULATIONS FOR INTERNATIONAL GEOGRAPHICAL CONGRESSES

(*Approved by the General Assembly, at Brussels, on* 15 *April* 1924, *with a small correction to Regulation II approved by the General Assembly, at Cambridge, on* 17 *July* 1928.)

I. The object of International Geographical Congresses is to assist the progress of Geography by facilitating personal relations between the geographers[1] of different countries, and the discussion of geographical questions.

The Congresses include: (1) meetings for the discussion of general questions; (2) meetings for the discussion of local questions of special interest to the organizing country; (3) geographical excursions.

II. The General Assembly of the I.G.U. decides the country and the date for the holding of an International Geographical Congress. Notification of place and date is to be made to Governments and to the National Committees for Geography, which will inform the individuals and institutions interested.

The Local Organizing Committee may, in agreement with the President of the I.G.U., send *individual* invitations to attend the Congress to the geographers of countries not adhering to the Union but qualified to adhere.

III. The National Committee of the country in which the Congress is to meet is responsible for its organization, under the general control of the Executive Committee of the I.G.U.

It may form a special Organizing Committee for the purpose.

[1] The word *geographer* is intended to include explorers and topographers, navigators and hydrographers, geographical engineers, professors of geography and the allied sciences, officers and officials of Government geographical and cartographical services, the members of geographical societies and associations, and all those who are doing serious work in the field of geography.

RÈGLEMENT DES CONGRÈS INTERNATIONAUX DE GÉOGRAPHIE

L'Assemblée Générale de l'Union Géographique Internationale, réunie en avril 1924, a rédigé certains Règlements pour la conduite des Congrès Internationaux de Géographie, dont voici le texte:

PROJET DE RÈGLEMENT DES CONGRÈS INTERNATIONAUX DE GÉOGRAPHIE

(*Approuvé par l'Assemblée Générale à Bruxelles le* 15 *avril* 1924, *avec une petite correction de règlement II approuvée par l'Assemblée Générale, à Cambridge, le* 17 *juillet* 1928.)

I. Les Congrès Internationaux de Géographie ont pour but de favoriser le progrès de la Science Géographique en facilitant les rapports personnels entre géographes[1] de différents pays et la discussion des questions géographiques.

Ils comprennent: (1) des séances sur des questions générales; (2) des séances sur les questions locales intéressant spécialement le pays organisateur; (3) des excursions géographiques.

II. Le pays où, et la date à laquelle un Congrès International de Géographie aura lieu, sont décidés par l'Union Géographique Internationale en Assemblée Générale. Notification en est faite aux Gouvernements et aux Comités Nationaux de Géographie qui en avisent les personnes et les institutions intéressées.

Le Comité local chargé de l'organisation du Congrès, d'accord avec le Président de l'Union Géographique Internationale, peut inviter *individuellement* au Congrès, les géographes de pays non adhérents à l'Union Géographique Internationale, mais qui sont qualifiés à y adhérer.

III. Le Comité National du pays dans lequel doit se réunir le Congrès est chargé de son organisation, sous le contrôle général du Comité exécutif de l'Union Géographique Internationale.

Il peut nommer un Comité spécial pour cette organisation.

[1] Par géographes on doit entendre les explorateurs et topographes, les navigateurs et les hydrographes, les ingénieurs-géographes, les professeurs de géographie et sciences connexes, les officiers et fonctionnaires des services gouvernementaux de géographie et cartographie, les membres de sociétés et associations géographiques, et tous ceux qui font un travail sérieux dans le champ de la géographie.

IV. A Congress is composed of **ordinary** members and **invited** members, paying the same subscription, of which the amount is fixed by the Organizing Committee of the Congress.

Ordinary members are the geographers or geographical institutions belonging to countries adhering to the I.G.U. **Invited** members are geographers belonging to a country not adhering but qualified to adhere.

V. A Congress is held under the Presidency of the President of the Union, who will take the chair at all general meetings.

VI. The expenses of a Congress, so far as they are not paid for by the authorities of the country in which the Congress takes place, will be defrayed out of members' subscriptions. But the Executive Committee of the I.G.U. may be authorized by the General Assembly of the Union to make a grant out of the funds of the Union, as far as these may reasonably allow, in accordance with Statute VI, 15.

VII. The Organizing Committee is responsible for the publication of the Proceedings of the Congress, which will consist of scientific communications and reports, and, if considered desirable, reports on geographical excursions. The Committee may also publish excursion guide-books. It fixes the price, to members of the Congress, of the Proceedings and guide-books.

Note. As will be seen in paragraph (18) of the Report of the Meeting of the General Assembly on 15 April 1924, that Assembly decided, in principle, that:

(*a*) The ordinary meetings of the General Assembly of the Union should take place at the same epoch, and in the same place, as the International Geographical Congress; and

(*b*) The General Assembly should hold an ordinary meeting, as a rule, once every three or four years.

IV. Le Congrès comprend des membres **ordinaires** et des membres **invités** qui versent la même cotisation dont le montant est fixé par le Comité d'organisation du Congrès.

Sont membres **ordinaires** les géographes ou Institutions géographiques, appartenant à un pays adhérent à l'Union Géographique Internationale. Sont membres **invités** les géographes appartenant à un pays non adhérent mais qui est qualifié pour l'être.

V. Le Congrès se tient sous la présidence du Président de l'Union, qui présidera toutes les séances plénières.

VI. Les dépenses du Congrès, autant qu'elles ne sont pas couvertes par les Autorités du pays où le Congrès a lieu, seront défrayées par les cotisations. Mais le Comité exécutif de l'U.G.I. peut être autorisé par l'Assemblée Générale de l'Union à accorder sur ses fonds tel subside compatible avec ses ressources, d'après le paragraphe VI, 15 des Statuts de l'U.G.I.

VII. Le Comité d'organisation est chargé de la publication du compte-rendu du Congrès, lequel comprendra les communications et rapports scientifiques, et, s'il y a lieu, des rapports sur les excursions géographiques. Il peut aussi éditer des livrets-guides d'excursions. Il fixe le prix du compte-rendu et des livrets-guides pour les membres du Congrès.

Note. Comme il a été indiqué au paragraphe (18) du rapport de la séance de l'Assemblée Générale, le 15 avril 1924, l'Assemblée a décidé, en principe, que:

(*a*) les séances ordinaires de l'Assemblée Générale de l'Union auraient lieu à la même époque et au même endroit que les Congrès Géographiques Internationaux, et que,

(*b*) l'Assemblée Générale devrait convoquer une séance ordinaire, comme règle, une fois tous les trois ou quatre ans.

LIST OF ADHERING COUNTRIES IN JULY 1928

The following countries have adhered to the International Geographical Union:

Les pays suivants ont adhéré à l'Union Géographique Internationale:

Afrique du Sud	Italie
Argentine	Japon
Belgique	Maroc
Égypte	Pologne
Espagne	Portugal
États Unis d'Amérique	Roumanie
France	Suisse
Grande Bretagne	Tchécoslovaquie
Grèce	Yougoslavie (Royaume des Serbes, Croates, et Slovènes)
Hollande	

ORIGIN OF THE CONGRESS

The history of the origin of the Congress is described in the following notification which was transmitted to foreign Governments by the British Foreign Office asking, in the case of Adhering Countries, for lists of delegates appointed to represent their countries officially, and, in the case of other countries (except Russia), for lists of geographers to whom invitations should be sent. The National Committees for Geography of the Adhering Countries were also sent copies of the notification.

INTERNATIONAL GEOGRAPHICAL UNION

NOTIFICATION OF AN INTERNATIONAL GEOGRAPHICAL CONGRESS TO BE HELD IN ENGLAND IN JULY 1928

I. By the statutes of the International Geographical Union it is one of the duties of the Union to organize international congresses and committees of such congresses, and by the regulations for International Geographical Congresses, which were approved by the General Assembly of the Union, at Brussels, on 15 April 1924, the General Assembly of the Union decides the country and the date for the holding of an International Geographical Congress. Notification of place and date is to be made to Governments and to the National Committees for Geography, which will inform the individuals and institutions interested.

It is also laid down in the regulations that the National Committee of the country in which the Congress is to meet is responsible for its organization, under the general control of the Executive Committee of the International Geographical Union. It may form a special organizing committee for the purpose.

At the meeting of the General Assembly of the Union held at Brussels on 15 April 1924, it was, on the proposal of the British Delegates, unanimously decided that the International Congress of 1928 should be held in London.

II. In accordance with these statutes, regulations and resolutions, the British National Committee for Geography has taken preliminary steps to organize an International Geographical Congress, to be held in England and to commence on 18 July 1928.

III. The British National Committee is charged with the duty of deciding the town in which the Congress shall meet, for the regulations only lay upon the General Assembly the selection of the country. The National Committee, having given careful consideration to the matter, has decided that it will be for the general convenience of delegates, as well as in the interest of the good working of the Congress, if certain preliminary ceremonies are arranged to take place in London; but it is proposed that the scientific and business transactions of the Congress should be carried out in Cambridge. The Executive Committee of the International Geographical Union has taken no objection to this arrangement.

IV. The Congress will, therefore, be

THE INTERNATIONAL GEOGRAPHICAL CONGRESS, CAMBRIDGE, 1928.

The holding of the Congress at Cambridge has the approval of His Britannic Majesty's Government, of the Royal Society, of the Royal Geographical Society, and of the Council of the Senate of the University of Cambridge.

V. In accordance with the regulations which have been approved by the General Assembly of the Union, the Congress will be composed of *ordinary* members and *invited* members, paying the same subscription: *ordinary* members are the geographers or geographical institutions belonging to countries adhering to the International Geographical Union: *invited* members are geographers belonging to a country not adhering, but qualified to adhere.

Further information will be issued in a short time.

VI. All enquiries and correspondence with regard to the Congress should be addressed to:

THE SECRETARY,
INTERNATIONAL GEOGRAPHICAL CONGRESS,
GONVILLE AND CAIUS COLLEGE,
CAMBRIDGE.

SIGNED ON BEHALF OF THE ORGANIZING COMMITTEE OF THE INTERNATIONAL GEOGRAPHICAL CONGRESS OF 1928 BY:

BALFOUR, the Rt Hon. the Earl of, P.C., O.M., F.R.S., *Chancellor of the University of Cambridge.*

BARKER, W. H., Esq., M.A., *Reader in Geography at the University of Manchester.*

BARTHOLOMEW, Capt. JOHN, M.C., *Hon. Secretary, Royal Scottish Geographical Society.*

BIDDULPH, the Lord, *Treasurer of the Royal Geographical Society.*

BROWN, Dr R. N. RUDMOSE, D.Sc., *Head of the Department of Geography at the University of Sheffield.*

DE BUNSEN, the Rt Hon. Sir MAURICE, Bart., G.C.M.G., G.C.V.O., C.B., *Foreign Secretary, Royal Geographical Society.*

BUTLER, Sir GEOFFREY, K.B.E., *M.P. for Cambridge University.*

CHALMERS, the Lord, of Northiam, *Master of Peterhouse, Cambridge.*

CHARLESWORTH, Prof. J. K., *Professor of Geology, Queen's University, Belfast; Member of National Committee for Geography.*

CHISHOLM, G. G., Esq., LL.D., F.R.S.E., *formerly Head of Department of Geography, University of Edinburgh.*

CLOSE, Col. Sir CHARLES, K.B.E., C.B., C.M.G., F.R.S., *Vice-President of the Royal Geographical Society; Chairman of the National Committee for Geography; President of the Geographical Association,* 1927; *General Secretary of the International Geographical Union.*

COLLIE, Prof. J. NORMAN, Ph.D., LL.D., F.R.S., *Past President of the Alpine Club.*

CONWAY, Sir W. MARTIN, *Past President of the Alpine Club; Vice-President of the Royal Geographical Society; M.P. for the Combined English Universities.*

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CROSTHWAIT, Col. H. L., C.I.E., *formerly Superintendent, Survey of India.*

CURRIE, JAMES, Esq., LL.D., F.R.S.E., *Hon. Treasurer of the Royal Scottish Geographical Society.*

DARWIN, Major LEONARD, D.Sc., *Past President of the Royal Geographical Society.*

DEBENHAM, FRANK, Esq., O.B.E., M.A., *Secretary of the Executive Committee of the International Geographical Congress,* 1928.

DOUGLAS, Rear-Admiral H. P., C.M.G., R.N., *Hydrographer of the Navy; Member of the National Committee for Geography.*

DYSON, Sir FRANK, K.B.E., LL.D., F.R.S., *Astronomer Royal.*

EDDINGTON, Prof. A. S., F.R.S., *Plumian Professor of Astronomy, Cambridge.*

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FLEMING, Miss R. M., *Secretary of the Geographical Association.*

FLEURE, Prof. H. J., D.Sc., *Professor of Geography and Anthropology, University of Wales; Hon. Secretary of the Geographical Association; Member of the National Committee for Geography.*

FRAZER, Sir JAMES G., O.M., F.R.S., D.C.L., LL.D.

FRESHFIELD, DOUGLAS W., Esq., D.C.L., *Past President of the Royal Geographical Society; Past President of the Alpine Club.*

GARDINER, Prof. J. STANLEY, M.A., F.R.S., *Professor of Zoology, University of Cambridge.*

GILES, Dr P., Litt.D., *Master of Emmanuel College, Cambridge.*

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GREGORY, Prof. J. W., D.Sc., F.R.S., *Professor of Geology, University of Glasgow.*

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HADDON, Dr A. C., F.R.S., *lately Reader in Ethnology, University of Cambridge.*

HARDY, Sir WILLIAM B., K.B.E., F.R.S., *formerly Secretary of the Royal Society.*

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HOGARTH, Dr DAVID GEORGE, C.M.G., F.S.A., D.Litt., *President of the Royal Geographical Society; Keeper of the Ashmolean Museum, Oxford.*

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JACK, Col. Commandant E. M., C.M.G., D.S.O., *Director-General of the Ordnance Survey; Hon. Secretary of the Royal Geographical Society.*

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KINVIG, R. H., Esq., *Head of Department of Geography, University of Birmingham.*

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LEWIS, W. STANLEY, Esq., *Head of the Department of Geography, University College, Exeter.*

LUGARD, the Rt Hon. Sir FREDERICK, G.C.M.G., C.B., D.S.O., *Chairman of the Council of the International Institute of African Languages and Cultures; British Member of the Mandates Commission; formerly Governor of Hong Kong and Governor-General of Nigeria.*

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RISHBETH, O. H. T., Esq., M.A., *Professor of Geography, University College, Southampton.*

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[For Re-appointment of this Commission see p. 42.]

No. 2. Commission on the International Map of the World (Commission sur la Carte du Monde au Millionième)

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Major D. A. HUTCHISON, *Secretary of the Central Bureau.*

Members

The Heads of the official Geographical Services of the States adhering to the International Geographical Union. [See *Carte du Monde au Millionième: Rapport de* 1928, pp. 23–4, 33–4. This Commission was dissolved at the General Assembly on 17 July.]

No. 3. Commission on Pliocene and Pleistocene Terraces (Commission des Terrasses pliocènes et pléistocènes)

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Professor J. E. CHAPUT.
Professor CH. DEPÉRET.
Professor M. GORTANI.
Professor O. T. JONES, D.Sc., F.R.S.
Dr W. B. WRIGHT, Sc.D.
Dr K. S. SANDFORD, D.Ph., *Secretary.*

[For Re-appointment of this Commission see p. 44.]

SPECIAL SUBJECTS FOR CONSIDERATION BY THE CONGRESS (SUJETS SPÉCIAUX SOUMIS À LA CONSIDÉRATION DU CONGRÈS)

[See *Union Géographique Internationale: Rapport sur les Années* 1925 *et* 1926, pp. 24–5.]

Variation of Climates (Variation des Climats).

Vegetal and Animal Population of high Mountains (Peuplement végétal et animal des hautes Montagnes).

Regional Studies of Great Britain (Études régionales de la Grande Bretagne).

DELEGATES AND REPRESENTATIVES

*Delegates officially appointed to represent their countries are marked *.*

AFGHANISTAN

*M. M. YUNUS, Secretary of the Afghan Legation.

AFRIQUE DU SUD

Administration of S.W. Africa.

South African National Committee for Geography.

Dr S. H. HAUGHTON, Senior Geologist, Union Geological Survey Division.

South African Geographical Society.

Dr K. H. BARNARD.

ARGENTINE

Instituto Geográfico Militar, Buenos Aires.

Major B. DE BIEDMA.

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†Russell-Brown, Col. C., C.B., D.S.O.
†Ryder, Col. C. H. D., C.B., C.I.E., D.S.O.
†Said-Ruete, R.
Salzman, Miss N.
†Sanders, Miss E. M.
Sandford, Dr K. S., D.Ph.
Saner, Miss R.
†Sanger, Miss D.
Sayce, R. U.
Schofield, Miss J.
Sclater, W. L.
†Seligmann, Miss E.
Shackleton, Miss M. R.
Shaw, Miss E. M.
†Sifton, A. J.

GRANDE BRETAGNE (*suite*)

Simpson, Miss C. A.
Smith, Miss R. W.
Sowerbutts, T. W.
Spiller, H. H.
Stamp, Dr L. Dudley, D.Sc.
Stanners, R. W.
†Steers, J. A.
Stephenson, A.
Stevens, A.
Stewart, The Rev. M. J.
Strachan, J. M.
Strachey, Miss J. P.
Sutton, S. W. V.
Sylvester, Miss D.
Tavener, L. E.
Taylor, Miss E. G. R.
Tebbutt, Col. L.
Thomas, Dr H. Hamshaw.
Tipper, G. H.
Tipper, Mrs.
Underhill, J. P.
†Uvarov, B. P.
Warburton, J.
Webster, G. R. H.
Weekes, The Rev. G. A.
Weston, The Rev. W.
†Weston, Mrs F. E.
Willis, Dr J. C.
Willis, Mrs J. C.
Willis, Miss M.
Winterbotham, Col. H. St J. L., C.M.G., D.S.O.
Wordie, J. M.
Wrenick, Miss B. U.
Wright, Dr W. B., Sc.D.
Wright, Mrs W. B.
†Young, G. W. (*ob.* 4 Dec. 1929).
Younghusband, Lt.-Col. Sir Francis, K.C.S.I., K.C.I.E.

GRÈCE

†Skinas, Dr G., Ph.D.

HOLLANDE

†Boermann, Prof. W. E.
†Vink, Dr T.
Voûte, E. J.
Voûte, Mevrouw.

HONG KONG

Reed, E. B.

ÎLES SALOMON BRITANNIQUES

Knibbs, S. G. C.

INDE

Bharuche, F. R.
Browne, Lt.-Col. C. M., C.M.G., D.S.O.
Crone, D. R.
Melhuish, Commr. R. A.
†Stein, Sir M. Aurel, K.C.I.E., Ph.D., D.Litt., D.Sc.
Thomas, Lt.-Col. R. H.

INSTITUT INTERNATIONAL

Union Géodésique et Géophysique Internationale (Section de Géodésie).

IRLANDE

†Mew, G. H.
Scharff, Dr R. F., Ph.D.
Scharff, Mrs.

ITALIE

Almagià, Prof. R.
Almagià, Signora M.
Angelo, Prof. Maria d'.
Argentieri, Avv. V.
Biasutti, Prof. R.
Bognetti, Prof. G.
Calciati, Cav. Dr Conte Cesare (*ob.* 1 Sept. 1929).
†Caroli, Dr A.
Carrasco, Manuel.
Cavazza, Conte Filippo.
†Chiarugi, Prof. A.
†Colosi, Prof. G.
Costantini, Conte David.
Costantini, Contessa.
†Dainelli, Prof. G.
Della Valle, Cav. Dr C.
Desio, Dr A.
Elia, Conte G.
Errera, Prof. C. (Istituto di Geografia della R. Università di Bologna).
Filippi, Cav. Dr Filippo de, K.C.I.E.
Gigliucci, Conte Mario.
Gigliucci, Signorina Bona.
Gortani, Prof. Michele.

ITALIE (*suite*)

†Issel, Prof. R.
Lucchesi, Gr. Uff. R. Astuto di.
Mancini, Com. L.
†Marazzi, Dr B. C.
Marchetti, Prof. Adelaïde.
Marchi, Prof. L. de.
Marescalchi, Dr Maria.
Masi, Signora E. C.
Merciai, Prof. G.
†Moltoni, Prof. E.
Mori, Prof. A.
Negri, Prof. G.
Orazi, Comm. Dr N. M
Pandolfi, Cap. G.
Pellati, Conte F.
†Pinelli, F.
†Ronchetti, F.
†Ronchetti, Prof. V.
†Rovereto, Prof. G.
Rucellai, Conte Cosimo.
Rucellai, Contessa.
†Sanctis, Dr C. de.
†Santucci, Dr R.
†Sanzo, Prof. L.
Sciolette, Ing. G. B.
Sciolette, Prof. Emma.
Stefanini, Prof. G.
Toniolo, Prof. A. R. (Università di Pisa).
Tron, A.
Vacchelli, Gen. Nicola.
Vacchelli, Signorina A.
Vanni, Avv. G.
Vota, G.
Zambra, Comm. Rag. V.

JAPON

†Hachisuka, M. V.
Imamura, Gakuro.
Imamura, Mme Y.
Ishii, Col. E.
Komaki, Saneshige.
Nakamura, Ryonosuke.
Nishida, Yoshiro.
Suzuki, Prof. J.
Tachibana, Capt. S.
†Tanaka, Viscount A.
Tanaka, Kaoru.
Tanaka, Mme Kaoru.
Tanaka, Prof. Shusaku.

JAPON (*suite*)

Tokyo Geographical Society.
Uchida, Kan-ichi.
Uchida, Mme Tei.
Yamasaki, Prof. Naomasa (*ob.* 26 July 1929).
Yamasaki, Mme.

MAROC

Célérier, J.
Célérier, Mme.
Charton, A.
Lavalette, Col. de.

MEXIQUE

†Aguilar-Santillán, R.
†Contreras, Arq. Don Carlos.
Filatti, Mlle R.
†Sanchez, P. C.

NIGERIA

Evans, Capt. C. G.

NORVÈGE

Sömme, A.
Werenskiold, Prof. W.

NOUVELLE ZÉLANDE

†Tankard, T. S.
†Tankard, Mrs.

OUGANDA

Thomas, H. B.

PALESTINE

Brawer, Dr I., D.Ph.
Le Ray, H. G.

PÉROU

Hope-Jones, H.
Vallenas, Major B. G.
Vallenas, Señora.

POLOGNE

Bulawski, R. (Glówny Urząd Statystyczny).
†Bystroń, Prof. J. S.
Bzowski, C.
Bzowska, Mme.
Czekalski, Prof. J.
Firlus, Mlle G.
†Goetel, Dr W.

POLOGNE (*suite*)

Jakubski, Prof. Dr A.
Lencewicz, Prof. Dr S.
Loth, Dr Jerzy.
Pawlowski, Prof. Dr S., Ph.D.
Pietkiewicz, Por. S.
Polaczek, Dr Marie.
Romer, Prof. Eugenjusz.
Romer, Mme J.
Szymanska, Mlle B.

PORTUGAL

Lucas, Col. J. A. dos Santos (Sociedade da Geografia de Lisboa).

RHODESIA DU NORD

†Fairweather, W. G.

ROUMANIE

Institutul Geologic al României.
†Mrazec, Prof. L.
Pavelescu, Gen. I.
Vâlsan, Prof. Gh.

SIAM

Graham, W. A.

SIERRA LEONE

Dare, Major J., M.C.

SOUDAN

Colchester, G. V., M.C.
Grabham, G. W.
Hardie, R.

SUÈDE

Ahlmann, Prof. H. W.
†Geer, Baron Gerard de.
Nelson, Prof. Dr Helge.

SUISSE

Biermann, Prof. Ch.
Mercanton, Prof. Dr P. L.
†Montandon, R.

TCHÉCOSLOVAQUIE

†Danes, Dr J. V.
Kolářová, Dr F. N.
Machát, Dr F., Ph.D.
Machátova, Dr Helena, Ph.D.
Malík, Dr K.
Novák, Dr V. J.
†Pohl, Dr J.

TCHÉCOSLOVAQUIE (*suite*)

Rausch, Gen. K.
Švambera, Prof. V.
†Urban, Prof. K.
Vitásek, Prof. Dr F.
Wölfel, Por. J.

TERRITOIRE DU TANGANYIKA

†Gethin, P. E. L.

TURQUIE

Pertev Pasha, Brig.-Gen.

YOUGOSLAVIE (ROYAUME DES SERBES, CROATES, ET SLOVÈNES)

Bošković, Gen. S. P.
Milojević, Prof. B.
Milojević, Mlle A.
†Šenoa, Prof. M.
Vujević, Dr P.

TICKET OF MEMBERSHIP

I. G. U.

INTERNATIONAL GEOGRAPHICAL CONGRESS
CAMBRIDGE, 1928

TICKET OF MEMBERSHIP

Name ....

....

....

Signature ....

....
Secretary.

This Ticket entitles the holder to all the privileges of a Member of the Congress. It should be presented at the Assembly Room of the Congress on arrival.

DIARY OF THE CONGRESS

FRIDAY, 13 JULY.

Arrival of delegates and members in London. Bureau of the International Geographical Union opened at the House of the Royal Geographical Society, Kensington Gore, S.W. 7.

SATURDAY, 14 JULY.

10.30 *a.m.* Meeting of the Commission on the Carte du Monde, under the Presidency of Gen. VACCHELLI, President of the International Geographical Union, at the House of the Royal Geographical Society.

11.0 *a.m.* H.M. THE KING received the President and Executive Committee of the Union at Buckingham Palace.

3.30 *p.m.* Reception by the President, Col. Sir CHARLES CLOSE, and Council of the Royal Geographical Society, at the House of the Society, of all members of the Congress.

SUNDAY, 15 JULY.

5.0 to 7.0 *p.m.* Reception at the Science Museum, South Kensington; the Geographical, Meteorological, Geodetic and Astronomical Collections were open to inspection, by permission of the Board of Education.

(A special collection of maps of the British Empire was on view in the Science Museum during the whole of July, from 10 a.m. to 6 p.m. on weekdays and 2.30 p.m. to 6 p.m. on Sundays.)

MONDAY, 16 JULY.

10.30 *a.m.* Meeting of the Executive Committee of the Union, at the House of the Royal Geographical Society.

11.0 *a.m.* Exhibition of manuscript and early engraved Maps at the British Museum described to members of the Congress by Mr F. P. SPRENT.

3.0 *p.m.* Second Meeting of the Commission on the Carte du Monde.

8.0 *p.m.* Reception and Conversazione offered by the Lord Mayor of London and the Corporation of the City of London to the members of the Congress at the Guildhall and honoured by the presence of H.R.H. THE PRINCE OF WALES.

TUESDAY, 17 JULY.

Members of Congress proceeded to Cambridge. (A special train ran from King's Cross at 11.0 a.m.) On arrival at Cambridge, inscription of names in the Reception Room at the Arts School, Bene't Street.

3.30 *p.m.* Meeting of the General Assembly of the International Geographical Union in the Main Hall, Arts School. Appointment of Finance Committee, Presentation of Reports of Commissions, etc. On conclusion of the meeting of the General Assembly, meeting of all members of the Congress for appointment of two Vice-Presidents of Congress and Officers of Sections.

WEDNESDAY, 18 JULY.

12.0 *noon.* Formal Opening of the Congress in the Senate House by the VICE-CHANCELLOR of the University of Cambridge, the Rev. G. A. WEEKES, Master of Sidney Sussex College.

Inaugural Address of the President, Gen. VACCHELLI.

Wednesday, 18 *July* (*continued*).

2.40 *p.m.* Photograph of members of the Congress taken in front of the Senate House.

2.45 *p.m.* General Meeting of Congress in Main Hall, Arts School, to receive the report of the Commission of the Carte du Monde.

3.15 *p.m.* Lecture by Mr O. G. S. CRAWFORD on "Air Photography and Archaeology."

4.0 *p.m.* Prof. J. E. MARR conducted members of the Congress round the Sedgwick Museum of Geology.

4.0 *p.m.* Invitation to tea by THE PRINCIPAL OF NEWNHAM COLLEGE. Lecture by Miss CATON-THOMPSON on "Recent Excavations in Egypt."

9.0 *p.m.* Reception by the Master of Emmanuel College, Dr PETER GILES, in the gardens of the College.

THURSDAY, 19 JULY.

10.0 *a.m.* to 12.30 *p.m.* Meetings of Sections.

SECTION A.

10.0 *a.m.* Prof. G. BOGNETTI, "The Touring Club Italiano and its geographical Activity."

10.45 *a.m.* HUSSEIN SIRRY Bey, "The New Atlas of Egypt."

11.30 *a.m.* Col. E. LESTER JONES, "Geographic Importance of Coastal Surveys."

12.15 *p.m.* Conte C. CALCIATI, "The Map of the Karakoram."

SECTION B.

10.0 *a.m.* Prof. W. W. ATWOOD, "The Physiography of San Juan Mountains of Colorado."

10.30 *a.m.* Prof. J. W. GREGORY, "Raised Beaches and Variations of Sea-level."

11.0 *a.m.* H. C. DARBY, "Observations on the Analysis of Quaternary Time."

11.30 *a.m.* Prof. G. STEFANINI, "Fluviatile and Marine Terraces of Italian Africa."

12 *noon.* Prof. G. VÂLSAN, "Les Terrasses de la Plaine roumaine."

SECTION C.

10.45 *a.m.* B. P. UVAROV, "Orthoptera of Mountains in the Palaearctic region." (Read by Dr R. F. Scharff.)

11.30 *a.m.* Prof. G. NEGRI, "Vegetal and Animal Population of high Mountains."

SECTION D.

10.0 *a.m.* Rt Hon. Sir HALFORD MACKINDER, "The Content of Philosophical Geography."

10.40 *a.m.* Conte D. COSTANTINI, "Studies and Researches on Prehistoric Man and his Origins."

11.10 *a.m.* Prof. Y. NISHIDA, "Cities of Japan."

11.40 *a.m.* Prof. M. SORRE, "L'Écologie de l'Homme."

12.10 *p.m.* Prof. MUSTAFA AMER, "Some Problems of the Population of Egypt."

SECTION E.

10.0 *a.m.* Sir GEORGE FORDHAM, "Une Enquête Manquée—les Cassini et leurs Travaux cartographiques."

10.35 *a.m.* HENRI DEHÉRAIN, "L'Œuvre géographique de la France dans le Levant du XVII[e] au XIX[e] Siècle."

11.10 *a.m.* Prof. R. ALMAGIÀ, Presentazione dell' Opera "Monumenta Cartographica Italiae."

11.45 *a.m.* Conte F. PELLATI, "La Carta archeologica d'Italia."

12.0 *noon.* Dr H. CASTRO, "Comments on an Expedition to San Lorenzo de Nutca in the Eighteenth Century."

12.30 *p.m.* O. G. S. CRAWFORD, "A proposed Map of the Roman Empire."

SECTION F.

10.0 *a.m.* Major-Gen. Lord EDWARD GLEICHEN, "The Spelling and Pronunciation of Geographical Place-Names for British Use."

10.35 *a.m.* T. ALEXANDER BARNS, "The Basins of the Congo and Kasai."

11.10 *a.m.* Dr C. B. FAWCETT, "Regional Planning in England and Wales."

11.45 *a.m.* Dr A. DESIO, "The Morphology of Marmarica and the Libyan Desert."

2.30 *p.m.* Meeting of the Executive Committee of the International Geographical Union.

3.0 *p.m.* Meeting of the Commission on Rural Settlement in the room of Section D.

3.0 *p.m.* Meeting of the Commission on Pliocene and Pleistocene Terraces under the Presidency of Prof. HERNÁNDEZ-PACHECO, in the room of Section B.

2.0 *p.m.* Excursion A to Ely and Wicken Fen (original undrained fen). Leader: Prof. J. STANLEY GARDINER.

2.0 *p.m.* Excursion B. Geology of the Chalk Area south of Cambridge. Leader: Mr W. B. R. KING.

4.0 *p.m.* Members of the Congress visited the Museum of Archaeology and Ethnology by invitation of THE CURATOR.

9.0 *p.m.* Lecture by the DEAN OF NORWICH (Very Rev. D. H. S. CRANAGE, Litt.D., F.S.A.) on "Cambridge: the Town and University," in the theatre of the Arts School.

FRIDAY, 20 JULY.

10.0 *a.m.* to 12.30 *p.m.* Meetings of Sections.

SECTION A.

10.0 *a.m.* A. R. HINKS, "Edward Wright and Mercator's Projection."

10.40 *a.m.* Col. Sir C. CLOSE, "The Transverse Elliptical Equal-Area Projection of the Sphere."

11.20 *a.m.* G. T. MCCAW, "The Polyconic as a World Map."

12 *noon.* Prof. W. WERENSKIOLD, "The Figure of the Earth."

SECTION B.

10.0 *a.m.* Dr V. J. NOVÁK, "The Results of the Investigation of River-Terraces in Bohemia."

10.30 *a.m.* Prof. S. LENCEWICZ, "Les Terrasses de la Vistule moyenne."

Friday, 20 *July* (*continued*).

11.0 *a.m.* Prof. S. Pawlowski, "Pleistocene Terraces in Poland."
11.30 *a.m.* Prof. J. E. Chaput, "Le Rôle des Surfaces polygéniques dans le Modelé."
12.0 *noon.* Prof. Rafael de Buen, "Origen de las Rías."
12.30 *p.m.* Conte C. Calciati, "La Speleologia in Italia."

Section C.

10.0 *a.m.* Prof. J. Barcroft, "Life at High Altitudes."
11.0 *a.m.* Dr R. F. Scharff, "Rapport de la Société de Biogéographie de la France sur le Peuplement des hautes Montagnes."
11.30 *a.m.* Prof. A. W. Jakubski, "A Statistical Survey of Faunistic Literature in Poland up to 1880."

Section D.

10.0 *a.m.* Prof. Deffontaines, "Un Type de Peuplement dispersé en Slovaquie."
10.30 *a.m.* Prof. M. Vahl, "The Distribution of the Population of Denmark."
11.0 *a.m.* Conte G. E. Elia, "The International Relief Union and a Geographical Atlas of Calamities."
11.30 *a.m.* Dr K. Malík, "River-Transport in Czechoslovakia."
12 *noon.* W. A. Graham, "Distribution of the Races of Further India."

Section E.

10.0 *a.m.* Prof. R. Almagià, "Per una Collezione sistematica di Riproduzioni di Carte antiche delle diverse Regioni europee."
10.40 *a.m.* Hussein Sirry Bey, "A Unique Arabic Translation of Ptolemy's Geography."
11.25 *a.m.* Dr W. F. Hume, Presentation of "La Bibliographie de l'Égypte."
11.30 *a.m.* Rt Hon. Sir Halford Mackinder, "Two Suggestions for the early Historical Geography of England."
12 *noon.* E. L. Stevenson, "Early Spanish Mapping of the New World. The Padron Real."

Section F.

10.0 *a.m.* Dr A. Desio, "Notes on the Giarabub (Jaghbub) Oasis."
10.45 *a.m.* Prof. G. Parmentier, "L'Origine des Noms des Lieux au Spitsberg."
11.30 *a.m.* Prof. A. R. Toniolo, "An Atlas of Italian Landscape."

3.0 *p.m.* General Meeting of Congress in Main Hall, Arts School, to discuss the Report of the Commission on Rural Settlement, and other matters.

2.30 *p.m.* Excursion C to Travellers' Rest Gravel Pit. Leaders: Prof. J. E. Marr and Mr W. B. R. King.

4.0 to 6.0 *p.m.* Reception by the Vice-Chancellor of the University, the Rev. G. A. Weekes, in the Gardens of Sidney Sussex College.

SATURDAY, 21 JULY.

10.0 *a.m.* to 12.30 *p.m.* Meetings of Sections.

SECTION A.

10.0 *a.m.* Prof. A. CHOLLEY, "L'Atlas photographique du Rhône."
10.45 *a.m.* J. LÉOTARD, "De l'Utilité de répandre la Connaissance des Faits géographiques par leur Représentation graphique."
11.30 *a.m.* Col. E. LESTER JONES, "Geodetic Surveys in North America."
12.15 *p.m.* A. UZEL, "Short Study of American aerial photographic Methods."

SECTION B AND SECTION E.

10.0 *a.m.* Prof. J. W. GREGORY, "Variations of Climate in the Past."
10.25 *a.m.* Prof. P. FOURMARIER, "Recherches sur les Variations des Climats au Cours des Périodes géologiques."
10.50 *a.m.* Prof. J. L. MYRES, "Climate in Prehistoric Greece." (Read by Prof. O. H. T. Rishbeth.)
11.15 *a.m.* Prof. G. B. BARBOUR, "The Nature and Origin of the Loess Deposits of China."
11.40 *a.m.* Dr MARIE POLACZEK, "Climatic Variations in Poland from the End of the Fifteenth to the Middle of the Seventeenth Century."
12.5 *p.m.* E. BÉNÉVENT, "Sur la Variabilité du Climat dans les Alpes françaises."
12.25 *p.m.* Prof. L. DE MARCHI, "Projet d'une Étude à Collaboration internationale sur les Variations des Climats."

SECTION C.

None.

SECTION D.

11.0 *a.m.* Dr S. VERE PEARSON, "Causes of Rural Depopulation."
12 *noon.* Prof. B. Ž. MILOJEVIĆ, "La Science géographique et la Géographie humaine."

SECTION E. *See* SECTION B.

SECTION F.

10.0 *a.m.* H. C. DARBY, "Tenby Coast—a local Shore Study."
10.40 *a.m.* H. HOPE-JONES, "The Internal Drainage Area of Collao."
11.20 *a.m.* Prof. G. PARMENTIER, "Le Chemin de Fer de montagne de Bergen à Oslo."
12 *noon.* K. UCHIDA, "Distribution of Cultivated Land in Japan Proper."

2.0 *p.m.* Congregation of the Senate of the University of Cambridge for the conferring of Honorary Degrees by the Vice-Chancellor in the Senate House. The degree of Sc.D. was conferred upon Gen. NICOLA VACCHELLI, Prof. EMMANUEL DE MARTONNE, and Col. Sir CHARLES CLOSE.

1.30 *p.m.* Excursion D. The Meres of Breckland (botanical). Leader: Mr F. T. BROOKS.

3.0 *p.m.* Excursion E to Ely Cathedral. Leader: Prof. V. R. CREED.

Saturday, 21 *July* (*continued*).

3.0 *p.m.* Excursion F to Hinchingbrooke by Huntingdon (private art collection in house formerly owned by the Cromwell family). Leader: Col. Sir Gerald Lenox-Conyngham.

9.0 *p.m.* Reception at the Scott Polar Research Institute by Dr H. R. Mill, Acting Chairman of the Committee of Management.

Sunday, 22 July.

8.0 *a.m.* Excursion G to Blakeney Point. Leader: Prof. F. W. Oliver. Reception at Blakeney Point by Lord Ullswater. *See* General Report, p. 39.

8.0 *a.m.* Excursion H to Jurassic Rocks of Northamptonshire. Leader: Mr T. C. Nicholas.

10.0 *a.m.* Excursion I. Fenland (agricultural). Leader: Mr F. L. Engledow.

10.0 *a.m.* Excursion J. Grimes Graves and Breckland. Leaders: Mr J. M. Wordie and Mr T. C. Lethbridge.

9.0 *p.m.* Organ Recital by Dr Alan Gray in Trinity College Chapel.

Monday, 23 July.

10.0 *a.m.* to 12.30 *p.m.* Meetings of Sections.

Section A.

10.0 *a.m.* Col. E. Lester Jones, "Geographic Boundaries."

10.40 *a.m.* Col. Penel for Gen. Bellot, "La Carte du Sahara au 500,000^{e}."

11.20 *a.m.* Col. de Lavalette, "Emploi de la Photographie aérienne pour le Levé des Cartes de Reconnaissance au Maroc."

12 *noon.* R. A. Pelham, "The Influence of a Fourteenth-Century MS. Map of Britain on Sixteenth-Century Cartography."

Section B.

10.0 *a.m.* Prof. E. Romer and J. Sabatowska, "Some Remarks upon Interior Basin Drainage."

10.30 *a.m.* Dr W. F. Hume, "The Significance of Folding and Faulting in the Orography of Egypt and Sinai."

11.0 *a.m.* Prof. N. Yamasaki, "Acute and Chronic Tilting of Land Blocks in Japan."

11.30 *a.m.* L. Aufrère, "L'Orientation des Dunes continentales."

12 *noon.* Prof. E. Romer and S. Albert, "The geographical Distribution of thermic Asymmetry."

Section C.

None.

Section D.

10.0 *a.m.* Prof. R. Biasutti, "Rural Settlement in Italy."

10.30 *a.m.* Mlle Foncin, "Habitat rural dans les Maures."

11.0 *a.m.* J. Lozach, "Enquête sur l'Habitat rural en Égypte." (Read by Prof. A. Cholley.)

11.30 *a.m.* G. Hug, "Habitat rural dans la Moyenne Égypte." (Read by Prof. A. Cholley.)

12.0 *noon.* Miss D. Sylvester, "Rural Habitation in Shropshire."

SECTION E.

10.0 *a.m.* Sir GEORGE FORDHAM, "Les Cartes géographiques et l'Histoire."

11.10 *a.m.* S. KOMAKI, "La Nécessité des Études de la Géographie préhistorique."

11.45 *a.m.* Conte F. PELLATI, "Il Lavoro archeologico dell' Italia a Rodi e nel Dodecaneso."

12.20 *p.m.* HUSSEIN SIRRY Bey, "Description of a unique Ptolemaic World-Map."

SECTION F.

10.0 *a.m.* Cav. Dr F. DE FILIPPI, "Presentation of new Volumes of Scientific Reports of the de Filippi Expedition in the Himalayas, Karakoram, and Chinese Turkistan (1913–1914)."

11.0 *a.m.* Sir A. E. KITSON, "Certain Aspects of the Gold Coast."

11.45 *a.m.* Prof. P. ARANEGUI, "Orography of the Spanish Basque Country."

2.0 *p.m.* General Meeting of Congress in Main Hall, Arts School, to discuss the Report of the Commission on Pliocene and Pleistocene Terraces, and other matters.

3.0 *p.m.* Lecture by H.R.H. THE DUKE OF APULIA on "The Tripolitanian Sahara," in the theatre of the Arts School.

2.0 *p.m.* Excursion K. South-East Cambridgeshire (archaeological; villages and parishes). Leaders: Dr PALMER and Mr J. JONES.

3.0 *p.m.* Excursion L to Audley End (building begun in 1603 by Lord Thomas Howard). Leader: Lady DARWIN.

4.0 *p.m.* Invitation to tea by the MISTRESS OF GIRTON COLLEGE.

9.0 *p.m.* Lecture by Lt.-Col. Sir FRANCIS YOUNGHUSBAND on "The Shaksgam Valley," in the theatre of the Arts School.

TUESDAY, 24 JULY.

10.0 *a.m.* to 12.30 *p.m.* Meetings of Sections.

SECTION A.

10.0 *a.m.* Dr H. JEFFREYS, "Near Earthquakes."

10.40 *a.m.* E. A. REEVES, "True Bearing and Distance Diagram."

11.20 *a.m.* A. R. HINKS, "Retro-azimuthal Projection of the whole Sphere."

12 *noon.* Prof. E. ROMER, "Hachure in recent Cartography."

SECTION B.

10.0 *a.m.* Prof. G. PARMENTIER, "Le Maëlström."

10.30 *a.m.* G. IMAMURA, "Abrasion Platforms along the Pacific Coast of Japan."

11.0 *a.m.* Prof. P. FOURMARIER, "L'Origine du Réseau hydrographique du Congo."

11.30 *a.m.* Prof. A. R. TONIOLO, "Per lo Studio delle Variazioni dei Litorali sabbiosi del Bacino Mediterraneo."

12 *noon.* Com. L. MANCINI, "Sur l'Exploration scientifique de la Mer rouge."

12.30 *p.m.* Dr M. AWAD, "Some Stages in the Evolution of the River Nile."

Tuesday, 24 *July* (*continued*)

SECTION C.

None.

SECTION D.

10.0 *a.m.* Mlle M. LEFÈVRE, "Classification générale des Types d'Habitat."

10.30 *a.m.* Miss S. HARRIS, "Rural Habitation in Western France and the Channel Islands."

11.0 *a.m.* Miss E. HALLIWELL, "Rural Habitation in the Upper Derwent Basin."

11.30 *a.m.* H. A. INNIS, "Industrialism and Settlement in Western Canada."

12.0 *noon.* Dr WALENTY WINID, "The Distribution of urban Settlements in the north central United States." (Read by Dr Jerzy Loth.)

SECTION E.

10.0 *a.m.* E. L. STEVENSON, "Real and imaginary Conditions as determining Factors in geographical Discovery."

10.45 *a.m.* H. K. SELIM, "Trade Relations of Egypt in the Middle Ages."

11.30 *a.m.* Miss E. G. R. TAYLOR, "A Cambridge Geographer: Master John Dee."

12.0 *noon.* J. N. L. BAKER, "The English Climate in the Seventeenth Century."

SECTION F.

10.0 *a.m.* Prof. W. W. ATWOOD, "Research and Educational Work in a Graduate School of Geography."

11.20 *a.m.* Col. E. LESTER JONES, "The National Geographic Society."

12 *noon.* Col. E. ISHII, "Precise Levelling across the central Range of Formosa and the Determination of the Altitude of Mt Niitaka."

2.0 *p.m.* General Meeting of Congress in the theatre of the Arts School. Lecture by M. CH. DE LA RONCIÈRE on "Manuscrits perdus de Voyageurs français des XV^e et XVI^e Siècles."

2.45 *p.m.* Lecture by Prof. D. W. JOHNSON on "Physiography of the Atlantic Coast of North America."

3.30 *p.m.* Prof. E. DE MARTONNE, Présentation du Rapport sur l'Extension des Régions privées d'Écoulement vers l'Océan.

4.0 *p.m.* Exhibition in Main Hall, Arts School, by Mr A. G. OGILVIE, of Maps of the Moray Firth Coast, and by Dr HAMSHAW THOMAS of Air-Photographs of Blakeney Point and Desert Sand-Dunes in Sinai and Palestine.

7.30 *p.m.* Dinner given by H.M. Government, in Trinity College hall, the Rt Hon. Sir AUSTEN CHAMBERLAIN, K.G., M.P., H.M. Secretary of State for Foreign Affairs, presiding.

9.45 *p.m.* Reception given by H.M. Government in St John's College to all members of the Congress, the Rt Hon. Sir AUSTEN CHAMBERLAIN receiving the guests.

WEDNESDAY, 25 JULY.

10.0 *a.m.* Meeting of the General Assembly of the International Geographical Union in Main Hall, Arts School. Report of Finance Committee. Commissions and Resolutions. Place of Meeting of the next Congress and General Assembly. Election of new President and Executive Committee of the Union.

General Meeting of Congress. Vote of thanks to the Vice-Chancellor and authorities of the University. Vote of thanks to and address by the Retiring President, Gen. VACCHELLI. Closure of Congress.

THURSDAY, 26 JULY.

Start of General Excursions A, B, and C. *See* General Report, pp. 39–41.

GENERAL REPORT

At the meeting of the General Assembly of the International Geographical Union held at Brussels in 1924 it was proposed by the British delegates and unanimously decided that the Congress of 1928 should be held in England. In accordance with the statutes of the Union the British National Committee for Geography, originally constituted by the Royal Society, became responsible for the organization; and they decided that the general convenience of delegates would be best suited if certain preliminary ceremonies took place in London but the administrative and scientific meetings at Cambridge. This was approved by His Majesty's Government, by the Royal Society, by the Royal Geographical Society, and by the University of Cambridge. An executive committee was appointed to have full charge of the work of organization, in which they were much indebted to the Royal Geographical Society for financial support, the Royal Society being unable to make a contribution. The Congress was fixed for 18–25 July.

On Thursday, 12 July, an office of the International Geographical Union was opened in the Council Room of the Royal Geographical Society, London, where delegates of the Union and members of the Congress could notify their arrival, book accommodation at Cambridge, and obtain general information, special railway tickets, etc. A selection of books and maps from the Society's collection[1] was laid out for inspection in the Reading Room and Map Store, and all the available sheets of the Carte du Monde were on view in the Map Room. The first Conference of the Commission of the Carte du Monde was held in the Map Room on Saturday morning, 14 July, under the presidency of General Vacchelli, the chief business at this meeting being the consideration of the proposals made by the Central Bureau after correspondence on the questions raised at Cairo. A decision was arrived at on all points; the report, drawn up by the Secretary of the Central Bureau, was passed at the second meeting of the Conference on Monday afternoon, 16 July, for subsequent presentation to the International Geographical Congress at Cambridge. The Commission concluded its labours with the consideration of a few additional points raised by delegates; and a telegram of greeting was sent by the Conference to Prof. A. Penck, the initiator of this international undertaking[2].

[1] See Appendix, p. xxxv.
[2] See *Carte du Monde au Millionième: Rapport de* 1928, Southampton, 1929; and *Geographical Journal*, October 1928, LXXII, pp. 363–5.

On Saturday morning the President, General Vacchelli, and the Executive Committee of the International Geographical Union had the honour of being received at Buckingham Palace by H.M. the King. In the afternoon the President (Col. Sir Charles Close) and Council of the Royal Geographical Society held a reception at the House of the Society to which all members of the Geographical Congress were invited to meet the delegates of the International Map Conference; and on Sunday afternoon, 17 July, there was a reception at the Science Museum, South Kensington, at which the Geographical, Meteorological, Geodetic, and Astronomical Collections were open to inspection by permission of the Board of Education. Both receptions were favoured with exceptionally brilliant and hot weather. The Royal Geographical Society's House was open on Sunday for the convenience of members of the Congress.

On Monday morning, 16 July, Mr F. P. Sprent kindly described a special exhibition of manuscript and early engraved maps in the King's Library of the British Museum[1]. In the evening there was a reception and conversazione at the Guildhall by the Lord Mayor and Corporation of the City of London, honoured by the presence of H.R.H. the Prince of Wales. The Guildhall Museum with its collection of Roman and other objects and the Library with its historical documents and valuable books were on view, while for the lighter entertainment of the guests there were music and dancing.

This concluded the London programme, and on Tuesday, 17 July, the members migrated to Cambridge. Meanwhile the news had been received that the Secretary of the Executive Committee, Mr F. Debenham, of Caius College, had been taken ill on the eve of the Congress; universal sympathy was felt for him in that, having done much preparatory work, he could not be present at the opening. However, he had recovered sufficiently by Monday, 23 July, to take some part in the proceedings. In his absence Mr J. M. Wordie, of St John's College, had undertaken the secretarial duties; he was assisted by a local committee of ladies and gentlemen under the chairmanship of Sir Gerald Lenox-Conyngham. Local arrangements for ladies were in the hands of a committee presided over by Lady Darwin.

The headquarters of the Congress were at the Arts School in Bene't Street. The smaller Examination Room was fitted up as a Reception Room, with an Information Bureau opening from it, where members could obtain the badge—an appropriate ornament, with the World drawn upon the Transverse Mollweide Projection[2], described by

[1] For full list see Appendix, p. xxv. [2] See Title page.

Sir Charles Close in a sectional paper on 20 July—excursion tickets, postal facilities, and various books and pamphlets. These included *Great Britain, Essays in Regional Geography by Twenty-six Authors*, edited by Mr A. G. Ogilvie, which alone was worth the membership fee of £1, three I.G.U. Reports on Rural Settlement (No. 1), Pliocene and Pleistocene Terraces (No. 2), and Regions of Inland Drainage (No. 3), a map of Cambridge on the scale of 12 in. to a mile specially prepared by H.M. Ordnance Survey, a catalogue of old maps exhibited by Sir George Fordham, a pamphlet by Sir Charles Close on the history of Geographical Congresses, and a handbook, list of members, and guide-book to excursions of the present Congress. General Meetings of Congress were held in the large Examination Room, where were exhibited, on screens, sheets of the International Map and specimens of work by the Geographical Section of the General Staff, while at the back of the room there was an exhibition of modern geographical books. Maps and books presented to the Congress were laid out on tables in the Reception Room. The University Library arranged an exhibition of old atlases in the cases in Cockerell's Building[1]. Sir George Fordham's exhibition of old maps at the Department of Geography comprised eighty specimens, arranged to illustrate British Cartography from the sixteenth to the nineteenth century, and included Saxton's map of England and Wales originally made about 1584 and maps derived from it, such as *The Quarter Master's Map* prepared by Hollar in 1644 for use in the Civil War; there were also fine examples of work by Cary and his successors[2].

Tuesday, 17 July, was chiefly occupied by members in settling into their temporary quarters. Some stayed with friends or put up at hotels; others were accommodated in colleges, particularly at Caius, Christ's, Pembroke, St Catharine's, St John's, Sidney, and Trinity, and it is hoped that these will have pleasant memories of their college life. In the afternoon, under the presidency of General Vacchelli, there was a General Assembly of the International Geographical Union at which only representatives of the nineteen adhering countries were entitled to be present. The agenda included the nomination of the Finance Committee (Gen. Bourgeois, Gen. Gómez Núñez, and Capt. J. Bartholomew); a decision that the unit of contribution should in future be five pounds sterling (one pound sterling being considered equivalent to 25 gold francs); the presentation of the Reports of the Commissions on the International Map, Rural Settlement, and Pliocene and Pleistocene Terraces (the two latter Commissions being

[1] For full list see Appendix, p. xxx. [2] For full list see Appendix, p. xxxi.

re-appointed); proposals for a uniform character and the better exchange of publications; and a modification in Regulation II for Congresses to the effect that the President and not the Executive Committee of the I.G.U. should be consulted by the Local Organizing Committee in sending invitations to individual geographers of countries not adhering to the Union. This meeting was immediately followed by a General Meeting of the Congress, at which Gen. Gómez Núñez and Prof. Yamasaki were nominated Vice-Presidents of the Congress, and Presidents, Vice-Presidents and Secretaries of Sections were appointed[1].

The Congress was not formally opened until noon on Wednesday, 18 July, in the Senate House, when the Vice-Chancellor, the Rev. G. A. Weekes, Master of Sidney Sussex College, in welcoming members to Cambridge, said that, just as 700 years ago a party of Franciscan friars under the leadership of an Italian came to Cambridge to study under the shelter of the University, so now the geographers of the world had come there to carry on their discussions in a congenial atmosphere *inter silvas Academi*. He remarked that the study of Geography had made rapid progress in this country in the twentieth century; in Cambridge a Readership in Geography was founded some ten years ago, and a Readership in Geodesy in 1922. But, though the Department of Geography now had a building of its own, it was the Cinderella of the University and still awaited a princely benefactor to raise it from its state of poverty. What struck the Vice-Chancellor most about modern geographical study was the number of sciences it laid under contribution, so that he was left wondering if indeed "there are more things in heaven and earth than are dreamt of in your philosophy." With that he declared the Congress open and wished it success.

The President, Gen. Nicola Vacchelli, then delivered his opening address in Italian; an English translation was in the hands of his hearers[2]. After sketching the history of English exploration and the activities of the Royal Geographical Society, the address emphasized the conception of "geography as a study of the rational subordination of space to man" and maintained that, though the period of discoveries is far from finished, man needs an intensive knowledge of the territories of the known world. The President touched upon some of the problems to be brought before the Congress, and in a happy phrase hoped that these few days of cheerful strain (*lieta fatica*) would contribute to the progress of our science. The audience rose at his concluding

[1] For full list see p. 2. [2] For full texts see pp. 52–60.

words of homage to H.M. the King and of gratitude and good wishes to the British Nation.

Members were soon called upon to maintain cheerfulness under strain, as they stood in blinding sunshine in front of the Senate House to pose for a photograph. The next event of the afternoon was a General Meeting to receive the report of the Commission of the Carte du Monde. There followed in the Arts School theatre an admirably lucid and concise lecture by Mr O. G. S. Crawford on Air Photography and Archaeology, illustrated by lantern slides from air photographs. Later on, members were conducted round the Sedgwick Museum of Geology by Prof. J. E. Marr, and among the exhibits saw an interesting model of the Cambridge district, showing the terraces to be visited at the Travellers' Rest Gravel Pit two days later and also a morphological show-case in which hand specimens appear side by side with photographs of the corresponding land-forms. The social events of the day were a tea-party given by the Principal of Newnham, where Miss Caton-Thompson lectured on Recent Excavations in Egypt, and an evening reception at Emmanuel College, where in the illuminated courts and gardens the Master, Dr Peter Giles, received the guests, whose diversity of academical robes added to the picturesqueness of the scene.

The mornings of Thursday, Friday, Saturday, Monday, and Tuesday were devoted to meetings of the six Sections, though Section C finished its programme in a couple of days.

The places for Sectional Meetings were as follows: A, Mathematical: Lecture-Room B in the Arts School; B, Physical: Lecture Theatre in the Arts School; C, Biological: Small Lecture-Room, Dept. of Geography; D, Human: Large Lecture-Room, Dept. of Geography; E, Historical: Lecture-Room C in the Arts School; F, Regional: Sedgwick Museum of Geology.

The excursions which were organized for the afternoons are noted later. In Cambridge the afternoon of Thursday, 19 July, was occupied by meetings of the two Commissions and by a visit to the Museum of Archaeology and Ethnology by invitation of the Curator. In the evening in the Arts School theatre the Dean of Norwich, Dr Cranage, gave a charming and humorous lecture on Cambridge, the Town and University.

On Friday, 20 July, there was a General Meeting to discuss the *Report of the Commission on Rural Settlement*, at which a number of members, following the Secretary, Prof. H. J. Fleure, made interesting speeches. But in the somewhat oppressive atmosphere of the

afternoon the Congress was glad to adjourn to a reception by the Vice-Chancellor under the trees of Sidney Sussex gardens.

At a Congregation of the Senate on Saturday afternoon, 21 July, the Vice-Chancellor conferred the degree of Doctor of Science on Gen. Nicola Vacchelli, Prof. Emmanuel de Martonne, and Col. Sir Charles Close. The recipients were presented with appropriate Latin orations by Mr J. C. Lawson of Pembroke College, acting for the Public Orator.

During the evening a limited number of members of the Congress attended a reception given by the Committee of Management of the Scott Polar Research Institute. They were received by Dr H. R. Mill, Acting Chairman of the Committee, and, after viewing the exhibits of polar pictures, books, and examples of sledging material, they repaired to the garden, where Dr Mill gave a short address dealing with the aims of the Institute.

Saturday afternoon and the whole of Sunday naturally gave opportunities for excursions and other gatherings, as well as for more informal "prowling about the city," to quote the apt phrase used by Sir Charles Close in his account of *International Geographical Congresses* (p. 15), where he tolerantly deplores the effect upon Congress business of the lure of Rome. The brilliant weather added much to the pleasure of the week in Cambridge.

On Sunday evening there was an organ recital by Dr Alan Gray in Trinity College Chapel.

Monday saw a return to the more serious side of Congress activities in all Sections, except that of Biological Geography, which had, as noted above, ceased to function. The afternoon of this day was occupied by a General Meeting of Congress to discuss the *Report of the Commission on Pliocene and Pleistocene Terraces* and by a lecture by H.R.H. the Duke of Apulia on the Tripolitanian Sahara. The Mistress of Girton invited a limited number of members to tea at the College. In the evening Sir Francis Younghusband described the Shaksgam valley, a region of special interest to those who were familiar with Major Kenneth Mason's stereographic survey and the reduction of that work with the Wild Stereo-plotter[1].

In the afternoon of Tuesday, 24 July, in the Arts School theatre, there were three lectures to a General Meeting. M. Ch. de la Roncière dealt with some lost manuscripts of early French travellers, Prof. Douglas Johnson with sea-level changes in North America, and Prof. de Martonne with the work he had done, in collaboration with M.

[1] See *Geographical Journal*, October 1927, LXX, pp. 342–71.

Aufrère, on *L'Extension des Régions privées d'Écoulement vers l'Océan*, already published as a report for the present Congress in pursuance of a resolution passed at Cairo in 1925.

This was followed by an exhibition, in the large room, of a series of large-scale maps arranged by Mr A. G. Ogilvie to illustrate the fluvio-glacial beaches, the raised terraces, etc., of the Moray Firth coast, together with a set of aeroplane photographs of Blakeney Point and Desert Sand-Dunes in Sinai and Palestine arranged by Dr Hamshaw Thomas.

The dinner given by H.M. Government at Trinity that evening naturally stands out as the most brilliant of the social gatherings. The necessary limitation of the number of guests to 150 must have given an unenviably difficult task to the selectors. The general reception afterwards in St John's College was very well attended. The actual ceremony of reception in the finely panelled Gallery of St John's, dimly lit by candlelight, was a picturesque event, and the music at both functions was a joy to hear, especially Stanford's *Elizabethan Pastoral*, sung towards the end of the Trinity Dinner.

Sir Austen Chamberlain, at the Dinner, proposing the toast of "The Sovereigns of the Kingdoms and Presidents of the Republics represented," said that it was nearly 60 years since the first Congress of that kind was held. With great frankness he deplored the absence of representatives from Germany. "He knew circumstances had caused Germany to be unrepresented, and similar circumstances might have been pleaded by German statesmen as a reason for refraining from joining the even more important society, the Society of Nations. They took a larger and wiser view both of their duty to the world and of their own interests. They were welcomed to that great society as colleagues and friends. They contributed fully to the discussions; and he hoped that before long, before the next Congress meeting, the German scientists would do what the German Government had done, and accept the welcome which was waiting for them." [*The Times*, 25 July 1928.]

The arrangements for the closing day, Wednesday, 25 July, corresponded roughly with those of the opening afternoon—a Meeting of the General Assembly of the Union[1] which, its business done, dissolved to make way for a General Meeting of the Congress.

The report of the Finance Committee signed by General Bourgeois

[1] For full account of the Assemblies of the Union on 17 and 25 July see *Union Géographique Internationale: Rapport pour la période du 1 janvier 1927 au 1 septembre 1928*, pp. 16–30.

showed that the sum to the credit of the Union was £886. 7*s*. 10*d*., and that the income for the year 1928 will be between £322 and £400, according as the 19 states adhering to the Union and putting up 80 units of contribution have arranged to pay on the old scale of 500 French francs, or the new, 125 gold francs = £5 sterling. The sum of £400 is to be transferred from the funds of the Union to those of the Congress to assist in the publication of the Report. Generally, the Finance Committee was satisfied that the position indicated covers anticipated expenditure, including the cost of publication of the reports of the various Commissions, no change being necessary in regard to the units of contribution made by the adhering states.

Other matters discussed were the continuation of the Terraces Commission, together with the continuation of the Commission on Rural Settlement and the acceptance of Sectional recommendations to form new Commissions to deal with the following matters:

(1) Variations of Climate in historic times, as proposed by Prof. de Marchi and Prof. de Martonne in Section B.

(2) Study of Fauna and Flora of Mountain Regions, as proposed by Prof. Biermann and Prof. Rudmose Brown in Section C.

(3) Palaeogeographical Maps for the plio-pleistocene epochs, as proposed by Prof. Biasutti in Section D. This Commission is recommended to get into touch with representatives of geology.

(4) Map of the Roman Empire on the scale of 1/M as described by Mr O. G. S. Crawford and formally proposed by Brigadier E. M. Jack in Section E.

(5) Photographs of selected ancient maps in the countries of Europe, following the model of *Monumenta Cartographica Italiana*, as proposed by Prof. Almagià in Section E.

Acceptance was also accorded by the Union to resolutions dealing with the following matters and not necessitating Commissions:

(i) Cartography of sand-dunes by Official Services (Section A).

(ii) Co-operation with the International Assistance Union, an offshoot of the League of Nations (Section D). The activities of this body touch the science of Geography in the matter of the proposed systematic collation of such data as have already appeared in various publications, particularly in *Matériaux pour l'Étude des Calamités*, and in the preparation therefrom of an *Atlas of Calamities*, which is the gist of the invitation put forward by Count Elia.

The General Assembly approved the proposal that the next Congress should be held at Paris in about three years' time. At this point Prof. Romer rose and was accorded leave by the President to make a

statement in which he expressed disappointment that the next Congress was not to be held at Warsaw, in response to the desire already twice expressed, at the first General Assembly of the Union at Brussels in April 1924 and again at the close of the Cairo Congress of 1925. Feelings of friendship and of sympathy with France prevented him from disputing the decision of the Union just announced, but he very earnestly hoped that consideration would be given to the invitation once again put forward on behalf of the geographers of Poland and in the name of its Government, who were anxious to accord to the Congress their hospitality. Gen. Vacchelli, in reply, assured Prof. Romer of the Union's gratitude and consideration for his proposal, observing however that the present General Assembly could take no decision which would tie the hands of the meeting in Paris. Resolutions were passed with regard to the periods of service of members of the Executive Committee, and the following officials for the next period were then unanimously elected:

Président: Général R. Bourgeois; 1er Vice-Président: Général N. Vacchelli; Vice-Présidents: Prof. N. Yamasaki, Général G. Severo Gómez Núñez; Sir Ahmed Hassanein Bey, Dr Isaiah Bowman, Col. Sir Charles Close; Secrétaire Général: Cav. Dr Filippo de Filippi.

The Assembly was then dissolved, to be succeeded after a short interval by the Final Meeting of the Congress. The Vice-Chancellor and authorities of the University were cordially thanked for their hospitality, and a vote of thanks was also passed to the retiring President.

In his closing address Gen. Vacchelli said that he was glad to conclude the labours of the Congress by stating that it had achieved a memorable stage in the progress of geography in its various aspects, mentioning especially the resolutions dealing with climatic variations within historical times, the formation of a programme dealing with the fauna and flora of high mountain regions, and collection in a complete catalogue of the various cartographical codices scattered in the libraries of Europe. He referred also in terms of high commendation to the volume *Great Britain*, and to the rapid advance which is being made in the *Carte du Monde au Millionième*. He was glad especially to welcome the representation of the United States of America among the adhering nations, the number of which had risen from fourteen to nineteen during his term of office, and repeated Sir Austen Chamberlain's hope that other countries, with valuable contributions to bring to geographical science, might see their way to join the Union. He concluded what all will feel were for him especially

days of *lieta fatica* by a happily phrased expression of gratitude to the various persons and bodies which had done so much to make the Congress a success, with sincere wishes for the prosperity of Great Britain.

During the Congress excursions by motor coach were organized chiefly to three regions, Ely and the Fenland, the chalk area south of Cambridge, and Breckland. Prof. J. Stanley Gardiner led a party to Ely and Wicken Fen on Thursday, Prof. V. R. Creed took another party to Ely on Saturday, and on Sunday Mr F. L. Engledow showed the agriculturalists the "black land" of the fens. The chalk area was visited on Thursday under the leadership of Mr W. B. R. King, and the villages of S.E. Cambridgeshire on Monday under that of Dr Palmer and Mr J. Jones, while in the opposite direction Mr T. C. Nicholas led an excursion to the Jurassic Rocks of Northamptonshire on Sunday. The visit of Saturday to the meres of Breckland was chiefly of botanical interest; the archaeological features of this district, including the flint-mines known as Grimes Graves, were the object of an excursion on Sunday organized by Mr J. M. Wordie and Mr T. C. Lethbridge. There were also visits to two historic houses, Sir G. Lenox-Conyngham taking a party on Saturday to Hinchingbrooke by Huntingdon, and Lady Darwin taking another on Monday to Audley End.

The most popular excursion was that to Blakeney Point organized by Dr H. Hamshaw Thomas, which occupied the whole of Sunday. Members were received at the Point by Lord Ullswater, Vice-President of the National Trust for the Preservation of Places of Historic Interest and Natural Beauty, the local committee of which had invited this visit from the Congress. Prof. F. W. Oliver explained the coastal formation, Dr E. J. Salisbury the vegetation, and Dr S. H. Long the birds of this remarkable spit, while Dr T. G. Hill gave a general description.

After the Congress there was a choice of three longer excursions, two from Thursday to Saturday, and one lasting a week.

(A) Prof. O. H. T. Rishbeth led a party to Oxford, Newbury, Salisbury, Southampton, and London. At Oxford the party, under the guidance of Prof. J. L. Myres, visited the Colleges, learning, *pace* the Congress handbook, that Cambridge was not unique in the number of its Colleges. They were also entertained at the School of Geography by Mr H. O. Beckit. The first night was spent at Newbury, where the Mayor and Mr Harold Peake explained the interesting

features of the Museum. On the way to Salisbury, Beacon Hill near Highclere Castle was climbed and afforded a very fine view. The route from Salisbury to Southampton was down the Avon valley and through the northern part of the New Forest. On the following morning Brigadier E. M. Jack welcomed the party at the Ordnance Survey Office, where the various technical processes were explained by the staff. The final stage of the journey to London was by Portsdown, Butser Gap, Hindhead, and the Hog's Back.

(B) The excursion led by Prof. Rodwell Jones and Dr L. W. Wooldridge covered roughly the area of the London and Hampshire Basins, viewed from well-chosen strategic points—in the structural sense—such as Beacon Hill (near Ivinghoe), Marlborough, and Hindhead. At the first-named the leaders of the excursion gave illuminating accounts of the Chiltern Hills, the plains they overlook, and the gaps by which they are traversed. At Marlborough Mr C. C. Carter supplied an exceptionally able account of the beautiful and structurally remarkable country which forms the divide between the London Basin, represented by the Kennet prolongation, and the Hampshire Basin, into which the Vale of Pewsey leads by way of the upper Avon. The excursion was fortunate in having Mr O. G. S. Crawford at Stonehenge. The return journey was made by way of Romsey, Winchester, and Hindhead, where under the guidance of Dr Wooldridge the Western Weald was surveyed, and then by way of Guildford Gap and the commons of Ockham and Esher to London. Those taking part in this excursion gained a good insight into a characteristic English area.

(C) The third excursion, led by Prof. H. J. Fleure, assisted by Mr R. U. Sayce, visited Wales and the Welsh Marches. A party of forty started from Cambridge on Thursday, 26 July, and in driving via Northampton to Warwick and Stratford-on-Avon was able to observe the scarps crossing the English Midlands as well as the distribution of population, regional types of architecture, etc. On the second day the journey was from Stratford across Shropshire to the Dee valley and Bettws-y-Coed. The interest of the visit to Shrewsbury was enhanced by arrangements kindly made by Mr Webster, a Cambridge undergraduate. The scarps and volcanic masses of the Welsh Border, the drainage problems of the Dee, and the character of the Welsh plateau were specially observed. On the third day the party first visited Llyn Idwal, a typical cirque, and then followed the coast plateau to Carnarvon to see the characteristics of the Menai Straits. Returning to the mountains they visited the top

of Snowdon, and in the evening drove through Nant Gwynant and Aberglaslyn to Barmouth. The fourth day was given to west Wales, the estuaries of the Mawddach, Dysynni, and Dyfi being studied. The road by Cader Idris was unfortunately closed; but the day gave special opportunities for observation of the Welsh plateau. After a visit to the Devil's Bridge the evening drive was via the Teifi valley to Cardigan. On the fifth day the party first visited St David's and then drove via the long line of lowland from Haverfordwest to Carmarthen, Llandilo, and Brecon. The sixth day's journey was from Brecon across the scarps that bound the South Wales coalfield and down the Taff valley to Cardiff, where the party was kindly welcomed by the staff of the National Museum of Wales. In the evening the cars drove up the Wye valley to Tintern, Symond's Yat, and Ross, several of the party alighting to visit the Yat on foot. On the last day the return journey was made by the Cotswolds to Oxford, where the party made a short visit before breaking up.

COMMISSIONS AND RESOLUTIONS

The Commission on Types of Rural Habitation (Commission No. 1) was re-nominated with the same general instructions, with the addition that it was recommended as desirable, in the first instance, to arrange for the preparation, in as many different countries as possible, of maps showing the distribution of the different types of habitation, taking as an example the map of Belgium published by Dr M. A. Lefèvre[1]. The limitation of the power of co-optation is withdrawn, and the Commission has the power of co-opting a reasonable number of additional members.

The Commission will be composed as follows:

President: Prof. Demangeon.

Members: Prof. Biasutti, M. Dantin Cereceda, Prof. Fleure, Prof. Michotte.

Secretaries: Miss S. Harris, of the University of Wales, Aberystwyth, Dr M. A. Lefèvre, of the University of Louvain.

The Commission is in hopes of enlisting the following as collaborators; these may be co-opted on to the Commission:

Messrs J. Hug and J. Lozach, for Egypt.
Dr Bowman, for the United States.
Mr J. Célérier, for Morocco.
Mr Hazewinkel, for Holland.
Mr S. Pawlowski, for Poland.
Prof. Ch. Biermann, for Switzerland.
Prof. B. Milojević, for Yugoslavia.
Messrs Dvorsky and Deffontaines, for Czechoslovakia.

[1] The collaborators of the Commission on Rural Habitation after discussion at Cambridge were in agreement on the following points:

(1) Each collaborator will compile a map for his country showing the regions which are distinguished from one another by the distributions within it of the various types of habitat; regions of dispersed habitat, of nucleated habitat, etc.

(2) The following two definitions are accepted: "Regions of absolute dispersion are those with scattered habitations showing no agglomeration whatsoever"; "Regions of absolute concentration are those in which the habitations are exclusively gathered together into a compact, nucleated settlement."

(3) The intermediate types of distribution are not defined. Each will distinguish them according to the characteristics observed in his own country.

(4) The map drawn up by collaborators should be accompanied by notes giving, especially, a description of the different types of distribution marked, the reasons

COMMISSIONS ET RÉSOLUTIONS

La nomination de la **Commission de l'Habitat Rural (Commission No. 1)** fut renouvelée en y ajoutant la recommandation qu'il serait à désirer, en premier lieu, d'organiser, dans un aussi grand nombre de pays que possible, la préparation de cartes montrant la distribution des différents types de l'habitat rural en prenant comme modèle la carte de la Belgique publiée par le Dr M. A. Lefèvre[1]. La restriction imposée au droit de cooptation a été retirée et la Commission aura le pouvoir de coopter des membres additionnels en nombre raisonnable.

La Commission sera ainsi composée:

Président: Prof. DEMANGEON.

Membres: Prof. BIASUTTI, M. DANTIN CERECEDA, Prof. FLEURE, Prof. MICHOTTE.

Secrétaires: Mademoiselle S. HARRIS, de l'Université du Pays de Galles, Aberystwyth, Dr M. A. LEFÈVRE, de l'Université de Louvain.

La Commission espère accueillir comme collaborateurs les messieurs dont les noms sont donnés ci-après. Ils pourront être cooptés à la Commission:

MM. J. HUG et J. LOZACH, pour l'Égypte.
Dr BOWMAN, pour les États Unis.
M. J. CÉLÉRIER, pour le Maroc.
M. HAZEWINKEL, pour la Hollande.
M. S. PAWLOWSKI, pour la Pologne.
Prof. CH. BIERMANN, pour la Suisse.
Prof. B. MILOJEVIĆ, pour la Yougoslavie.
MM. DVORSKY et DEFFONTAINES, pour la Tchécoslovaquie.

[1] Points sur lesquels les collaborateurs de la Commission de l'Habitat Rural se sont mis d'accord, après discussion, à Cambridge.

(1) Chaque collaborateur dressera une carte de son pays sur laquelle seront délimitées les régions qui se distinguent les unes des autres par le mode de répartition des maisons: régions d'habitat dispersé, d'habitat concentré, etc.

(2) On a admis les deux définitions suivantes: "les régions de dispersion pure sont celles dans lesquelles se remarque un éparpillement absolu des maisons, sans agglomération aucune"; "les régions de concentration pure sont celles où le peuplement est exclusivement composé de maisons resserrées en noyaux compacts."

(3) Les types de répartition intermédiaires n'ont pas été définis. Chacun les distinguera d'après les modalités observées dans son pays.

(4) Les cartes dressées par les collaborateurs seront accompagnées de commentaires comprenant notamment: la description des différents types de répartition

Re-appointment of the Commission on Pliocene and Pleistocene Terraces. (Commission No. 3.)

The Assembly unanimously approved of the re-appointment of the Commission to deal with the above subject, with the following modifications of the previous instructions and constitution:

1. The study will no longer be confined to Western Europe and the Basin of the Mediterranean. The problem is stated generally thus: "The study of coast and river terraces, with the object of investigating the existence of constant levels, and, if they exist, of fixing their succession." The title of the Commission will remain, **Commission on Pliocene and Pleistocene Terraces.**

2. The Commission is constituted as follows:

President: Sr D. EDUARDO HERNÁNDEZ-PACHECO.

Members: Prof. J. E. CHAPUT, Prof. C. DEPÉRET, Prof. M. GORTANI, Prof. D. W. JOHNSON, Prof. S. LENCEWICZ, Dr V. NOVÁK, Prof. G. VÂLSAN, Dr W. B. WRIGHT.

Secretary: Dr K. S. SANDFORD, University Museum, Oxford.

3. The Commission will remain in existence until the next meeting of the General Assembly, which will probably take place in September 1931.

4. Certain technical resolutions passed by the Section of Physical Geography (Section B) at the International Geographical Congress of 1928 are transmitted to the Commission for consideration and such action as the Commission may see fit to take.

NOTE. As before, the Commission has the power to co-opt additional members. It will receive communications and report on them, and, if considered necessary, may circulate a questionnaire. The Commission should publish a report at the expense of the Union.

for the occurrence of a particular type in a particular region; if possible, the period at which the type discussed arose, with indications of types which may have preceded it.

(5) In order to make the work as comprehensive as possible, collaborators should add plans, large-scale topographical maps, and, if possible, air photographs to illustrate the diverse modes of distribution of the habitat.

(6) In order to allow of the co-ordination of material, and of the compilation of the map, which it is hoped to present to the International Geographical Congress to be held at Paris in 1931, studies under the scheme of the Habitat Rural should reach the secretariat of the Commission *before October* 1930.

Renouvellement de la Commission des Terrasses Pliocènes et Pléistocènes. (Commission No. 3.)

L'Assemblée approuva à l'unanimité le renouvellement de la nomination de la Commission chargée de la question ci-dessus, en faisant, toutefois, les modifications ci-après aux instructions et à la constitution précédentes:

1. L'étude ne se bornera plus à l'Europe Occidentale et le Bassin de la Méditerranée. En termes généraux le problème est ainsi conçu: "L'étude des terrasses littorales et des terrasses fluviales dans le but de rechercher l'existence des niveaux constants et, s'ils existent, d'en fixer leur succession." La Commission sera désignée comme auparavant sous le titre de **Commission des Terrasses Pliocènes et Pléistocènes.**

2. La Commission est constituée de la façon suivante:

Président: Sr D. EDUARDO HERNÁNDEZ-PACHECO.

Membres: Prof. J. E. CHAPUT, Prof. C. DEPÉRET, Prof. M. GORTANI, Prof. D. W. JOHNSON, Prof. S. LENCEWICZ, Dr V. NOVÁK, Prof. G. VÂLSAN, Dr W. B. WRIGHT.

Secrétaire: Dr K. S. SANDFORD, University Museum, Oxford.

3. La Commission siégera jusqu'à la prochaine session de l'Assemblée Générale qui aura lieu, probablement, au mois de septembre 1931.

4. Certaines résolutions d'un ordre technique adoptées par la Section de Géographie Physique (Section B), au Congrès International de Géographie, 1928, sont transmises à l'attention de la Commission qui prendra les mesures qu'elle jugera à propos.

NOTE. Comme auparavant, la Commission aura le pouvoir de cooptation, et recevra des communications. La Commission pourra faire distribuer un questionnaire. La Commission devra publier un Rapport au dépens de l'Union.

constatés; les raisons pour lesquelles dans telle région se rencontre tel type de répartition; si possible, l'époque à laquelle le type actuel s'est établi et, en l'occurrence, l'indication des types qui peuvent l'avoir précédé, etc.

(5) Autant que faire se pourra, les collaborateurs joindront, au commentaire, des feuilles ou planchettes de cartes topographiques à grande échelle, comme représentation graphique des divers modes de répartition de l'habitat, et, si possible, des photographies prises en avion.

(6) Afin de permettre le travail de coordination et l'établissement de la carte d'ensemble qui sera présentée au Congrès international de géographie de Paris, il est souhaitable que les travaux parviennent aux secrétariats de la Commission de l'Habitat Rural avant le mois d'*octobre* 1930.

Commission for the Study of Climatic Variations. (Commission No. 4.)

Section B brought forward the following resolution:

Having in view the fact that there are already in existence serious studies on the question of the variability of climate, historical studies such as that of Dr M. Polaczek, and meteorological studies such as those of M. Bénévent, it is thought possible that the united efforts of scientists of different points of view might enable the facts of the problem to be determined, and some general conclusions to be arrived at. It is therefore suggested to the Executive Committee of the International Geographical Union, that, in agreement with the International Union of Geodesy and Geophysics, and other suitable Unions, a Commission should be appointed to study climatic variations, and to collect historical, physical, and biological evidence, relative to such variations, especially in the historical period, and omitting reference to periods before the pre-historic. The observations of Prof. L. de Marchi, of the University of Padua, should be considered in this connection.

The General Assembly approved of this resolution.

Commission for the Study of the Flora and Fauna Population of Mountains. (Commission No. 5.)

Section C of the Congress suggested the desirability of a Commission being appointed to report on the subject of the "Flora and Fauna Population of Mountains" at the next International Geographical Congress. The General Assembly approved of the proposal, and nominated the following to serve on the Commission:

Prof. Ch. Biermann	Switzerland
Prof. G. Negri	Italy
Dr R. F. Scharff	France

Commission for the Preparation of Palaeogeographical Maps. (Commission No. 6.)

Proposed by Section D, that in order to study the geographical environment of early man, an International Commission should be nominated for the preparation of palaeogeographical maps of the plio-pleistocene period. The General Assembly approved of the formation of this Commission, and nominated the following to serve on the Commission:

President:	Count D. Costantini	Italy
Members:	Prof. H. J. Fleure	Great Britain
	Prof. Emm. de Margerie ...	France
Secretary:	Prof. G. Stefanini	Italy

Other members can be co-opted.

Commission pour l'étude des Variations climatiques. (Commission No. 4.)

La Section B a présenté la résolution ci-après:

Vu qu'il existe déjà des études sérieuses sur la question de la variabilité des climats, études historiques comme celle du Dr M. Polaczek, et des études météorologiques comme celles de M. Bénévent, il paraît être possible que l'effort réuni de savants ayant des points de vue différents permettrait de préciser les données du problème et d'arriver à des conclusions générales. Il est donc suggéré au Comité Exécutif de l'Union Internationale de Géographie, d'accord avec l'Union Géodésique et Géophysique et les autres Unions qualifiées, qu'une Commission soit nommée pour l'étude des variations climatiques et chargée de rassembler des documents historiques, physiques et biologiques relatifs à ces variations, spécialement pendant la période historique et en omettant toute mention des périodes préhistoriques. Sous ce rapport les suggestions présentées par le Prof. de Marchi de l'Université de Padoue devront être considérées.

L'Assemblée Générale approuva cette résolution.

Commission pour l'étude du Peuplement végétal et animal des Montagnes. (Commission No. 5.)

La Section C du Congrès a suggéré qu'il serait désirable de nommer une Commission pour rapporter sur la question du "Peuplement végétal et animal des montagnes," au prochain Congrès International de Géographie. L'Assemblée Générale approuva cette proposition et nomma les membres suivants pour siéger à la Commission:

Prof. Ch. Biermann	Suisse
Prof. G. Negri	Italie
Dr R. F. Scharff	France

Commission pour la préparation des Cartes Paléogéographiques. (Commission No. 6.)

La Section D a proposé que, dans le but d'étudier le milieu géographique de l'homme primitif, une Commission Internationale soit nommée pour la préparation des Cartes Paléogéographiques de l'époque Plio-Pléistocène. L'Assemblée Générale a approuvé la constitution de ladite Commission et a nommé les membres dont les noms sont donnés ci-après, pour siéger à la Commission:

Président:	Le Comte D. Costantini ...	Italie
Membres:	Prof. H. J. Fleure	Grande Bretagne
	Prof. Emm. de Margerie ...	France
Secrétaire:	Prof. G. Stefanini	Italie

D'autres membres pourvront être cooptés.

Commission for the Preparation of a Map of the Roman Empire. (Commission No. 7.)

Section E presented a resolution that it would be of great interest from a historical and geographical point of view if an edition of the necessary sheets of the International Map on the scale of 1 : 1,000,000 were published, showing by an overprint the extent of the Roman Empire, with its main communications and other features of its organization, at the time of its greatest expansion; and that, in order to give effect to this purpose, a Commission should be appointed of representatives of the countries interested. The Commission should arrange for the publication of some of the sheets of the proposed edition before the next International Geographical Congress.

The General Assembly approved of the proposal and nominated the following to serve on the Commission:

President:	Brigadier E. M. JACK	Great Britain
Members:	Gr. Uff. Conte F. PELLATI ...	Italy
	M. CH. DE LA RONCIÈRE ...	France
	Dr H. CASTRO	Spain

The Commission to appoint its own Secretary and to have the power of co-opting additional members.

Commission for the Publication of Photographic Copies of Ancient Maps. (Commission No. 8.)

Section E also brought forward the following resolutions:

(1) That there should be established in each European country an Inventory of old maps preserved in public libraries or in private collections, relating to its territory.

(2) That a Commission of Experts should be appointed to make a selection of these documents and publish photographic reproductions, after the example furnished by the Monumenta Cartagraphica Italica.

The General Assembly approved of the resolutions and appointed the following to serve on a Commission to carry out the second resolution:

President:	Prof. R. ALMAGIÀ	Italy
Members:	Prof. EMM. DE MARGERIE ...	France
	Dr H. CASTRO	Spain

The Commission to appoint its own Secretary and to have the power of co-opting additional members.

Commission pour la préparation d'une carte de l'Empire Romain. (Commission No. 7.)

La Section E a présenté une résolution d'après laquelle il y aurait grand intérêt au point de vue historique et géographique, de publier une édition des feuilles nécessaires de la Carte Internationale au 1 : 1,000,000 avec surcharge montrant l'étendue de l'Empire Romain, ses principales voies de communications et autres formes de son organisation à l'époque de son plus grand développement, et qu'afin de donner suite à ce projet il serait utile de nommer une Commission composée de représentants des pays qui s'y intéressent. La Commission devra prendre des mesures pour assurer la publication d'un certain nombre des feuilles de ladite édition avant le prochain Congrès International.

L'Assemblée Générale approuva cette proposition et nomma pour siéger à la Commission:

Président:	Brigadier E. M. JACK ...	Grande Bretagne
Membres:	Gr. Uff. Conte F. PELLATI ...	Italie
	M. CH. DE LA RONCIÈRE ...	France
	Dr H. CASTRO	Espagne

La Commission devra nommer son Secrétaire et pourra coopter d'autres membres.

Commission pour la publication de reproductions photographiques des cartes anciennes. (Commission No. 8.)

La Section E a également proposé les résolutions ci-après:

(1) Qu'il soit établi dans chacun des pays de l'Europe un Inventaire des cartes anciennes conservées dans les bibliothèques publiques ou les collections privées et relatives à son territoire.

(2) Qu'un Comité d'Experts soit désigné pour faire un choix parmi ces documents et en publier une reproduction photographique, suivant l'exemple fourni par le Monumenta Cartagraphica Italica.

L'Assemblée Générale approuva ces résolutions et nomma les membres ci-après pour siéger à une Commission pour mettre en exécution la seconde résolution:

Président:	Prof. R. ALMAGIÀ	Italie
Membres:	Prof. EMM. DE MARGERIE	France
	Dr H. CASTRO	Espagne

La Commission nommera son Secrétaire et aura la faculté de coopter d'autres membres.

Resolutions not Involving the Appointment of Commissions

Section A brought forward the following resolutions:

That the cartography of sand-dunes presents a peculiarly important interest for the morphology of arid and semi-arid countries, and that it is possible to bring new and important facts to bear on the meteorology and climatology of regions of extensive size, where regular observations are wanting; and considering the progress that has been made in the representation of sand dunes by the Service Géographique de l'Armée Française and by the Survey of Egypt, as evidenced by the maps presented by Colonel Penel and the Atlas of Egypt presented by Hussein Sirry Bey, it is recommended:

1. That in countries in which the Official Services have undertaken surveys in regions where there are sandy or desert areas, surveys should be made, if possible, on a scale large enough to obtain an exact representation of the topographical features.

2. That conventional signs, allowing of incorrect interpretations being given morphologically and climatologically, should be avoided in insufficiently known regions. It is recommended that in such little known regions, the use of dots should replace that of dashes, crosses and stars; these dots will serve to indicate the presence of sand and dunes.

The General Assembly approved of these recommendations.

Section D brought forward the following resolutions:

The Assembly having taken cognizance of the Geneva Convention of 12 July 1927, establishing the International Assistance Union, which has been formed for the purpose of "Geographically locating the great scourges from which humanity suffers, determining their causes, studying their accidental or periodical recurrences, and finally, finding the most efficient means of anticipating, avoiding and fighting them," invites students of history and geography and Geographical Societies throughout the world to accept the responsibility of co-operation assigned to them in connection with the International Assistance Union and to contribute:

(*a*) To the preparation of an historico-geographical chart of calamities.

(*b*) To the investigation of geographical zones of calamities.

(*c*) To the study of the determinism of Nature's scourges.

(*d*) To the supply of correct scientific data for the technical and preventive preparation of the work of saving populations overtaken by great natural disasters.

The General Assembly approved of these resolutions.

Note. For further information on this subject application should be made to Gr. Uff. Count Commandant G. E. Elia, Vice-President of the Italian Geographical Society, Rome.

Résolutions ne comportant pas la Nomination d'une Commission

La Section A a proposé les résolutions ci-après:

Que la cartographie des dunes présente un intérêt particulièrement important pour la morphologie des pays arides et semi-arides et qu'elle est susceptible d'apporter à la météorologie et à la climatologie des données nouvelles et importantes pour des régions très étendues et dépourvues d'observations régulières; et, vu les progrès réalisés dans la représentation des dunes par le Service Géographique de l'Armée Française et par le Survey of Egypt démontrés par les cartes présentées par M. le Colonel Penel et l'Atlas d'Égypte présenté par M. Hussein Sirry Bey, il est recommandé:

1. Que dans les pays dont les services officiels ont entrepris des levés dans les régions où se trouvent des parties désertiques ou sablonneuses, on exécute, si possible, des levés à une échelle suffisamment grande pour obtenir une représentation exacte des formes topographiques.
2. Qu'on écarte pour les régions insuffisamment connues des signes conventionnels qui peuvent donner lieu à des interprétations morphologiques et climatologiques incorrectes. Il est recommandé que dans ces régions mal connues l'emploi des traits, des croissants et des étoiles soit remplacé par un pointillé indiquant qu'il y a du sable et des dunes.

L'Assemblée Générale approuve ces recommandations.

La Section D a présenté les résolutions ci-après:

L'Assemblée ayant pris connaissance de la Convention de Genève du 12 juillet 1927, établissant l'Union Internationale d'Assistance qui a été formée dans le but de "fixer géographiquement les grands fléaux dont souffre l'humanité, en déterminer les causes, étudier leur retour accidentel ou périodique et, finalement, découvrir les moyens les plus efficaces pour les prévenir, les éviter et les combattre, invite les étudiants d'histoire, de géographie et les sociétés géographiques du monde, d'accepter la responsabilité de coopération qui leur est attribuée par rapport à l'Union Internationale d'Assistance, et de contribuer:

(*a*) A la préparation d'un tableau historico-géographique de calamités.
(*b*) A la recherche des zones géographiques de calamités.
(*c*) A l'étude du déterminisme des fléaux de la nature.
(*d*) A fournir des données scientifiques exactes pour la préparation technique et préventive de l'œuvre du salut des populations frappées de grands désastres naturels.

L'Assemblée Générale approuva ces résolutions.

Note. Toute demande de renseignement sur cette question doit être adressée au Gr. Uff. Comte Commandant G. E. Elia, Vice-président de la Société Géographique de l'Italie, à Rome.

INAUGURAL ADDRESS

DELIVERED ON 18 JULY 1928 IN THE SENATE HOUSE BY THE PRESIDENT

GENERAL NICOLA VACCHELLI

In Egitto, ove forse l' uomo per la prima volta aveva misurato il suolo e seguito il corso degli astri, aveva cioè posto le prime fondamenta alla scienza della Terra, tre anni or sono i geografi raccolti a congresso vollero quasi consacrare lo spirito di rinascita di una parte di quell' Oriente che, chiuso da secoli in una severa immobilità, intende oggi marciare con noi sulle vie maestre della civiltà.

Era giusto che, dopo l' Egitto, la sede del Congresso Internazionale Geografico si trasportasse, in questa vecchia Britannia che dal grande secolo di Elisabetta in poi ha assunto la parte maggiore nelle scoperte e nella esplorazione delle più remote regioni della terra in questa gloriosa nazione che rappresenta, nella storia della civiltà, come la portatrice di quella fiaccola che richiama alla nostra alacre impaziente vita moderna i popoli incatenati al passato.

Nè più adatta e suggestiva sede poteva scegliersi di questo antichissimo ateneo di Cambridge, che conta ben sette secoli di vita operosa, e dove la grandezza delle tradizioni e la severità degli studi si temperano nel quadro ridente di una natura sapientemente ordinata a fare da sfondo e da cornice ai vetusti e nobilissimi edifici.

Già nel IX secolo il grande Re Alfredo promuoveva viaggi di scoperte in Scandinavia e nella Russia del Nord e davasi cura di far conoscere i viaggi dei due esploratori Othere e Wulfstano.

Ma la storia delle grandi scoperte marittime britanniche può ravvisarsi iniziata coi viaggi degli Italiani Caboto che trovarono in Inghilterra i mezzi per procedere, nei campi fin allora insolcati dell' Oceano, verso le mete cercate dagli arditi marinai di Bristol. E le imprese britanniche seguirono, poco dopo, per tutti i mari. E sempre l' Inghilterra si preoccupava che non andasse perduto il frutto delle imprese compiute, e sorgevano iniziative multiple, meravigliosamente secondate da enti pubblici e dai privati per raccogliere e conservare la storia delle scoperte sulla guida segnata dal nostro Ramusio fin dal 1550. Le raccolte di viaggi di Riccardo Eden, seguite da quelle del Hakluyt (1589) che dedicò tutta la sua vita alla geografia e alla storia, e del suo continuatore Purchas rappresentano ben un secolo di

operosità. Colla fondazione della Royal Society nel 1665, così benemerita per l' impulso dato alle ricerche in ogni ramo delle scienze, vennero anche gradatamente perfezionati e diffusi apparati e metodi scientifici nella esplorazione geografica.

Nella seconda metà del secolo XVIII la ricerca geografica, in ogni suo ramo, raggiunse in Inghilterra un immenso sviluppo. Sono infatti di questa epoca i tre grandi viaggi del Cook, la ripresa delle esplorazioni dell' Artiche, e anche l' inizio dei lavori di rilevamento dell' India. Questi lavori, incominciati dal Rennell, condussero alla esecuzione e al completamento della Grande Triangolazione, la più cospicua opera di geodesia che sia stata mai intrapresa da alcun paese. Sullo scorcio dello stesso secolo l' Ammiragliato Inglese iniziava anche le prime campagne idrografiche.

Diventava ormai necessario che una apposita istituzione assumesse il compito di tutelare le imprese geografiche, di far conoscere, appoggiare e promuovere le iniziative private, di segnalare e raccomandare al governo i più importanti problemi da indagare; e di raccogliere e conservare in apposite pubblicazioni i risultati delle imprese e degli studi geografici. Così vediamo sorgere nel 1830 la Royal Geographical Society.

A quell' epoca erano in corso viaggi nel Niger, nell' Antartico, in Mesopotamia, nel Turkestan.

Sotto gli auspici della Reale Società Geografica queste imprese si svilupparono e crebbero sempre più, estendendosi a tutta la terra in Africa (con nomi come Livingstone, Burton, Speke, Grant, Baker, e Stanley, uomini il cui nobile coraggio, la cui intelligente audacia e costanza onorano non solo la terra che fu la loro madre, ma l' intera umanità): nel Sud-America, in Australia, in Asia, nelle regioni antartiche, fino alle memorabili imprese di Shackleton e di Scott.

L' interesse, l' appoggio ed i premi di cui la Società Inglese divenne la depositaria non rimasero però circoscritte alle imprese dei connazionali, ma ne furono fatti partecipi i geografi e gli esploratori di qualunque altra nazione, mentre le sue pubblicazioni divennero l' organo informativo dei progressi geografici di tutto il mondo.

Con questi precedenti, non è da stupire che l' Inghilterra sia oggi il paese dove le imprese geografiche sono seguite col più generale interesse e consenso, e dove la coltura geografica, anche per quello che riguarda la storia della graduale conoscenza della Terra, è più diffusa.

Questa attività esploratrice scaturì naturalmente dalla vocazione coloniale, figlia a sua volta dello spirito di intraprendenza e della

preparazione marinara e commerciale del popolo Inglese, affacciato per mezzo del mare verso il più ampio orizzonte geografico.

Infatti: Durante il medioevo e al di fuori dell' antico mondo mediterraneo, le corporazioni di mercanti Inglesi avevano già intessuto la trama dello loro relazioni commerciali coll' Hansa Teutonica del Baltico, con i porti commerciali della Scandinavia, con quelli Francesi del Nord, e perfino con le nostre repubbliche marinare Italiane. E quando, scoperta l' America, l' Arcipelago Britannico venne a trovarsi agli avamposti dell' Europa verso il Nuovo Mondo, l' Inghilterra si trovò predisposta ed in condizioni favorevoli per incanalare verso l' Europa Centrale la novella fiumana di transito commerciale; fiumana analoga, ma ben più grande di quella che aveva avuto Venezia nei secoli precedenti per la ricchezza del Levante Mediterraneo.

E sebbene ad un secolo dalla scoperta del Nuovo Mondo, l' Inghilterra non avesse ancora fondata colonia alcuna, mentre Spagnoli e Portoghesi possedevano già vasti territori nei nuovi continenti, pure si comprende come questo popolo marinaro e commerciante avesse già preparazione e volontà per una azione coloniale estesa al mondo intero.

Lo stretto legame tra sfruttamento di materie prime, trasformazione industriale ed espansione commerciale, allargò l' orbita commerciale della Gran Bretagna fino ai limiti del mondo, e la portò alla costruzione del suo enorme impero coloniale, vero apparecchio d' appoggio per tutte le lontane imprese.

Fu detto che la storia non solamente si spiega colla geografia, ma si deve attuare nella geografia, perchè non può prescindere dal substrato materiale su cui si svolge; una prova evidente di ciò ne viene data dalla politica e dall' evoluzione del grande impero coloniale Inglese, che adatta metodi, forza e politica ai vari ambienti in cui agisce e con cui viene a trovarsi in contatto. I problemi di situazione, di demografia, di vie di comunicazione in relazione ad altri popoli ed altri paesi richiedono anzitutto una impostazione geografica.

Questa tendenza a concepire la geografia come studio per un razionale assoggettamento dello spazio all' uomo, va manifestandosi sempre più fra gli studiosi di ogni nazione.

La tendenza più spiccata delle società umane è stata in ogni tempo quella di occupare sul globo spazi via via maggiori. Tale tendenza non è determinata soltanto da bisogni diretti, ma anche dallo spirito di avventura, e dalla brama di penetrare l' ignoto.

Le necessità materiali umane si fondono con quelle intellettuali e psicologiche della specie, ed agiscono sugli individui singoli, sui

circoscritti aggregati sociali, e sulle grandi collettività umane. Ma oramai non basta più la conoscenza, diremo così, estensiva della Terra; occorre all' uomo anche la conoscenza intensiva.

La tecnica moderna ha messo a disposizione dell' uomo mezzi celerissimi di comunicazione, e i grandi spazi possono oggi essere superati in breve tempo. Se a questo si aggiunge il rapidissimo aumento della popolazione del mondo, per cui necessitano nuove terre, nuovi modi di attività, nuovi fonti di risorse, appare chiaramente tracciata la via agli studi geografici, che devono assumere e stanno infatti assumendo, più spiccato carattere antropico, politico ed economico.

Naturalmente la parte puramente scientifico-fisica della geografia non viene con ciò diminuita. Così pure la geografia non cesserà mai di dare il proprio contributo alle ricerche del passato sia umano, che terrestre, o cosmico; non cesserà mai di cooperare colle numerose scienze a lei affini, ma dovrà, nelle sue dirette esplicazioni, aderire maggiormente ai bisogni contigenti. Per realizzare tutto ciò, basta pensare per esempio agli intimi rapporti tra geografia ed areonautica; basta pensare a quel potente acceleratore di umani rapporti che è costituito dalla radiotelegrafia, dovuta ad un uomo che più che un uomo, io amerei meglio chiamare il benefico genio dell' etere: Guglielmo Marconi.

Il lungo periodo di pace anteriore al 1914, che aveva quasi cristallizzata l' economia e la politica del mondo civile, aveva favorito, come negli altri campi della scienza, un indirizzo puramente speculativo delle ricerche geografiche, indirizzo nel quale la geografia fisica e l' antropogeografia si erano quasi chiuse in un campo teorico fuori delle necessità pratiche della vita delle nazioni. Ma la guerra ha sconvolto queste concezioni, e coi poderosi problemi economici e politici imposti dall' opinione pubblica mondiale ha portato nuovamente in primo piano, ripeto, le questioni di geografia che sono alla base di ogni economia e di ogni politica. Ed è per questo che oggi l' attenzione dei geografi di tutto il mondo si fissa particolarmente sullo studio analitico dei vari territori, per conoscerne non solo le caratteristiche fisiche, ma le risorse naturali, l' abitabilità, le condizioni di popolamento in relazione alle necessità sempre crescenti dei popoli civili. I legami fra l' uomo e la Terra si moltiplicano, si estendono e si approfondiscono; ma si accentuano contemporaneamente le disuguaglianze fra regione e regione, tra popolo e popolo; quindi se in molti studi monografici la geografia fisica deve andare di pari passo con la geografia umana, ben presto questa tende a primeggiare per

l' interesse pratico che tali questioni hanno per la vita dei popoli. Con l' estendersi dei domini coloniali delle varie nazioni, e anche dei loro soli interessi antropici ed economici, si è diffusa sopra a tutto la necessità di studi particolari di geografia descrittiva ed economica, in cui l' uomo, nei suoi rapporti con l' ambiente, sta in primo piano.

Nè è a dirsi per questo che il periodo esplorativo sia finito; le calotte artica ed antartica richiedono ancora metodiche esplorazioni e vogliono purtroppo i loro martiri; il centro dell' Asia dell' Africa e dell' Australia e l' America equatoriale devono ancora mostrare al mondo le loro risorse; l' involucro atmosferico ora divenuto una nuova via di comunicazione, ha bisogno di nuove indagini e di ulteriori studi; ma ciò che oggi più urge all' economista, all' uomo di affari, al politico, è la conoscenza cartografica più completa possibile delle zone conosciute, la illustrazione spiegativa dei territori intanto accessibili all' espansione umana, e un giudizio comparativo per le regioni poco note.

Con tutto ciò non si vuol dire che problemi puramente scientifici o di divulgazione restino sottratti alla nostra considerazione. Già il Congresso Internazionale del Cairo del 1925 ne ha tramandati a questo Congresso di oggi alcuni di grande interesse. Così quello per il completamento della *Carta del Mondo al milionesimo*, opera immane, già largamente avviata e di grande interesse scientifico e pratico; *lo studio delle terrazze plioceniche e pleistoceniche di Europa* che dovrebbe avviare alla soluzione del problema della configurazione del suolo all' epoca della comparsa dell' uomo sulla terra; la *ricerca sulle forme assunte nei vari paesi dell' abitato rurale*, l' inizio di *ricerche metodiche sulle variazioni storiche dei climi*, che oltre ad importanza scientifica rivestono un interesse pratico di primo ordine; *l' inchiesta sul popolamento vegetale ed animale dell' alta montagna*, in quella zona limite dove ha luogo la manifestazione più espressiva dei rapporti del mondo biologico con quello fisico; infine il coordinamento degli studi circa il Mar Rosso, già avviati da varie nazioni; circa questo mare che rappresenta oggi la grande via di comunicazione tra l' Europa e l' Oriente.

Questi ed altri argomenti saranno dunque intanto portati dinanzi a Voi, perchè da una larga discussione, se non le soluzioni, che sarebbe troppo pretendere, pure escano ben stabiliti i principi metodici necessari ad affrontarli, e ben determinate quelle ripartizioni internazionali di lavoro che potranno condurre più rapidamente al compimento delle ricerche. E nuove questioni, nuovi problemi sorgeranno, che sarà Vostro compito saggiare e discriminare, per la collaborazione futura.

Io faccio pertanto voti che queste brevi giornate di lieta fatica contribuiscano vividamente a far progredire la nostra scienza geografica, e valgano, allo stesso tempo, a cementare sempre più tra Voi i legami di una stretta fraternità scientifica.

Ed ora, mentre stanno per iniziarsi i nostri lavori salga alla Maestà del Vostro RE l' espressione del nostro devoto e rispettoso omaggio, e alla nobile e potente nazione che ci ospita quella della nostra gratitudine con i voti più caldi di prosperità e di gloria.

THREE YEARS ago, in Egypt, the land where, perhaps for the first time, man had measured the earth and had followed the course of the stars, where he had laid the foundations of the science of the earth, geographers seemed to consecrate the spirit of renaissance of a part of that Orient, which, after having been closed for centuries in a profound stillness, intends to-day to walk along with us on the highroads of civilization.

It seemed right that after Egypt, the next meeting of the International Geographical Congress should take place in this old Britain, which since the great Elizabethan age has been foremost in the discoveries and explorations of the farthest regions of the earth; this England which in the history of civilization represents a torch-bearer beckoning the nations tied to the past to our hurried, vivid, modern life.

Neither could there be chosen a more suitable or suggestive place of meeting than this old University of Cambridge, which represents over seven centuries of studious life. Here the greatness of the traditions and the severity of the studies are mellowed out in the smiling picture of a nature wisely intended to be a worthy background to the old and noble buildings.

As early as the ninth century Alfred, the great Anglo-Saxon king, promoted travels of discovery, and, by means of translations and careful compilations in the language of the people, brought within everybody's reach the voyages of discovery in Scandinavia and in Northern Russia of the two well-known explorers, Othere and Wulfstan.

The real history of the British sea-voyages, however, can be considered as beginning with the travels of the Italian Cabot, who found in England the means to proceed and explore on the fields of the ocean the goals sought by the bold sailors from Bristol. Within a short time from then, British voyages were spreading out on all the seas. England was taking good care not to lose the result of her achievements, and there grew up numerous attempts, backed by public or private subscriptions, to collect and preserve the history of those discoveries, following, in this, the example set by our Italian Ramusio in 1550. The collection of travels of Richard Eden, followed shortly afterwards by that of Hakluyt (1589), who dedicated all his life to history and geography, and later still by the collection of Purchas, represent a whole century of work and study. In 1665, with the founding of the Royal Society, always ready to forward scientific researches of any kind, a gradual perfection of the scientific apparatus and methods necessary to geographical explorations was attained.

In the second half of the eighteenth century in England, geographical researches reached an extraordinary development in every branch. To this period belong the three famous journeys of Cook, the renewal of the explorations in the Arctic, and the beginning of the surveys of India. These surveys, begun by Rennell, led to the achievement and computation of the

Great Triangulation, the greatest and most perfect geodetic work that has ever been done by any one nation. Towards the end of that same century also, the English Admiralty started the first hydrographic surveys.

It then became necessary that an appropriate institution should assume the task of protecting geographical enterprises; of advertising, helping and promoting private initiative; of indicating and recommending to the government the most important problems worthy of research; and finally, of collecting and preserving in special publications the results of geographical voyages and studies. Thus the year 1830 saw the foundation of the Royal Geographical Society.

At that time there were in progress journeys in Nigeria, in the antarctic regions, in Mesopotamia, and in Turkistan.

Under the auspices of the Royal Geographical Society, these voyages developed and increased, ever covering more of the whole earth: South America, Asia, Australia, the antarctic regions, up to the memorable travels of Shackleton and Scott; Africa above all, where the names of Livingstone, Burton, Speke, Grant, Baker, and Stanley stand for men whose noble courage, intelligent audacity, and tenacity of purpose honour not only their own country but the whole of humanity as well.

However, the Royal Geographical Society did not limit its interest, help, and rewards to Englishmen alone; geographers and explorers of every other nation could take advantage of its activities, whilst at the same time its publications became the informative organ of geographical progress throughout the whole world.

Therefore it is not to be wondered at if, with these precedents, England should be to-day the country where geographical enterprises are followed with the greatest interest and approval, and where the science of geography is most extended, even for what concerns the history of a gradual knowledge of the earth.

The tendency towards active discoveries is naturally born of the colonial expansion, child in its turn of the enterprising spirit of the English people, which spirit had already prepared the conditions required to enlarge their geographical horizon.

In fact, during the Middle Ages, apart from the old Mediterranean basin, guilds of English merchants had already woven a network of commercial relations with the Teutonic Hanse of the Baltic, the commercial sea-ports of Scandinavia, those of northern France, and even with our Italian maritime republics. Therefore, when at the discovery of America, the British Archipelago came to find itself at the outposts of Occidental Europe, England was in a favourable position to direct towards central Europe the new current of trade; a current akin to, but much greater than, that directed and owned by Venice in the preceding centuries for the riches of the Mediterranean Levant.

At the beginning of the seventeenth century, when the national Anglo-Saxon union had been attained, and the various ethnical elements of the British Archipelago had been fused together, the government organized the insular dominion, making it impregnable from any continental domination; in this way the sea became an element necessary to the political and economic life of England, and it absorbed all the national activity.

And although more than a century after the discovery of America England had not founded any new colony, whilst Spain and Portugal owned already vast territories, yet we can understand how the English, a people of sailors and merchants, were already prepared for the exploration of the world. For over two centuries, the warm climates with their precious products attracted the commercial activity of England.

The close connection between exploitation of the raw material and the industrial transformation of it, as well as commercial expansion, brought the commercial boundaries of Great Britain to the world's outposts, and

created the construction of that enormous colonial empire without which any commercial structure would lack its main support.

It has been said that not only must history be explained by means of geography, but also that it is controlled by geography, and this because it cannot be detached from the material substratum upon which it grows and develops. An evident proof of this can be given by the politics and evolution of the great British Colonial Empire which adapts methods, powers and politics to the various milieux with which it comes in contact and in which it has to work. Problems of situation, demography, of ways of communication, all that is in relation to other peoples and other countries require above all a geographical basis, ever present to the mind of the English race, which considers the world as its own country.

This tendency to conceive geography as a study of the rational subordination of space to man is becoming ever more manifest among the scholars of every nation.

The main tendency of human societies has always been that of occupying greater and greater spaces on the globe. Such a tendency is not merely determined by direct needs, but by a spirit of adventure as well, and by the desire of penetrating the unknown.

Material and human blend with intellectual and psychological necessities and react upon single individuals, upon connected social aggregations, and upon great human masses. Nowadays an extensive knowledge of the earth is no longer sufficient; man needs also an intensive knowledge of it.

Modern technique has placed at man's disposal the swiftest means of communication, and great distances to-day can be covered in a short time. If to this consideration we add the fact that the world's population is rapidly increasing and needs new lands, new ways of activity and new resources, we see how clearly paved is the way to geographical studies, which have to assume and are indeed assuming particular ethnical as well as political and economic characteristics.

Naturally the value of the purely scientific side of geography is far from being lessened by this. Geography will never cease to give its contribution to the researches of the past, be they human, terrestrial, or cosmic; it will never cease to co-operate with its kindred sciences; but in its greater manifestations it will have to adhere to and respond to the present needs in a greater measure. In order to realize all this, it is sufficient to consider the intimate relationship between geography and aeronautics; it is sufficient to think of that powerful quickener of human relations, radio-wireless, due to a man that I should like to call the beneficent genius of the ether: Guglielmo Marconi.

The long period of peace previous to 1914, which had almost crystallized the economy and politics of the whole civilized world, had directed into a purely speculative channel geographical researches as well as all the other branches of science. This attitude had enclosed physical geography and anthropogeography in an academic limitation unconcerned with the practical necessities of the lives of nations. The war, however, upset all these conceptions, and together with the weighty economic and political problems imposed by the world's public opinion, brought into the limelight these questions of geography which are the bases of economy and politics. This explains why to-day the attention of geographers from all parts of the world is particularly directed towards the analytical study of the various territories, in order to know, not only their physical characteristics, but also their natural resources, their habitability, the growth of their populations in relation to the ever-growing necessities of civilized races. The bonds between man and the earth are growing in number and in quality, but, on the other hand, there are also accentuated the differences between region and region, between nation and nation; therefore if in many monographs physical geography has to go hand in hand with human geography, this latter science rapidly tends

now to take the upper hand by reason of the practical interest that it has for the life of the nations. With the extension of the colonial possessions of the different nations, and even of their purely ethnical and economic interests, there has grown up the necessity for special studies of descriptive and economic geography, in which man, in his relation to his surroundings, stands foremost.

We must not think, however, that the period of explorations and discoveries is finished; the arctic and antarctic caps require further methodical exploration and need new martyrs; the centre of Asia, Africa, Australia, and Equatorial America have yet to give the world their resources; the atmosphere, now a new route of communication, needs new investigations and further studies; but the most important thing to-day for the economist, the politician, and the business man is a complete cartographical knowledge of the known world, the explanatory illustration of the territories within reach of human expansion, and the comparative study of partially known regions.

We do not lack, however, purely scientific problems: the International Geographical Congress held in Cairo in 1925 has already transmitted to the Congress of to-day various problems of great interest. Thus for instance: *The completion of the Map of the World*, scale one to one million, a colossal work of great scientific and practical interest and one which is well on the path of execution; *the study of the pliocene and pleistocene terraces of Europe*, which should bring us to the solution of the problem of the configuration of the ground at the time of the appearance of man upon the earth; the research upon the forms taken by *rural habitations in the different countries*; the beginning of methodical researches upon the *historical variations of climates*—this besides its purely scientific importance is also of a very great practical interest; the inquiry into the *growth of the vegetal and animal population at high altitudes*, in that limit-zone which represents the most expressive manifestation of the relationship between the biological and the physical world; finally, *the co-ordination of the studies on the Red Sea*, a study already started by several nations and of the greatest importance, as the Red Sea represents to-day the great pathway of communication between Europe and the East.

These as well as other interesting arguments and problems will be brought before you, in order that an ample discussion of them, even if it will not reach a complete solution, yet will definitely establish the methodical principles necessary for the conquest of these problems, and will determine that international division of work which will lead us more rapidly to the completion of the research. Then new questions, new problems will arise; and it will be your task to choose and discriminate among them for future collaboration.

In the meantime I hope that these few days of cheerful strain will contribute to the progress of our science, and will cement among you the bonds of a close scientific friendship.

I cannot end these few words, however, without tendering to His Majesty your King the expressions of the most devout and respectful homage; at the same time I desire to offer to the powerful nation, whose guests we are, our deep gratitude and the warmest wishes for a continuation of its glory and prosperity.

CLOSING ADDRESS

DELIVERED ON 25 JULY 1928 BY THE PRESIDENT

GENERAL NICOLA VACCHELLI

JE SUIS heureux de pouvoir terminer les travaux de ce Congrès Géographique International par la constatation d'un progrès réel dans le développement de notre Science et de ses nombreuses ramifications.

En géographie mathématique comme en cartographie, les géographes anglais ont comme toujours apporté d'importantes contributions techniques et théoriques, tandis que plusieurs autres nations ont pris aussi une part active à cette branche importante de la Géographie.

Dans le champ de la géographie physique, largement cultivé depuis assez longtemps, de nombreuses nouvelles communications ont spécialement donné lieu à un progrès considérable pour l'élaboration des principes généraux sur lesquels se base cet argument, fertile en recherches. Il est à signaler tout spécialement en ce domaine la proposition d'un programme précis pour l'étude des variations des climats dans le courant de l'histoire, question qui a éveillé un très vif intérêt parmi les membres du Congrès.

Les contributions à la Section biographique n'ont pas été de moindre importance. Parmi les résultats obtenus, je dois signaler l'adoption d'un programme d'études sur la flore et la faune des montagnes, devant servir de base à la Commission qui va être nommée par l'Union Géographique Internationale.

D'urgents problèmes d'économie humaine et de géographie politique ont été le sujet de diverses communications concernant, soit l'adaptation humaine à l'ambiant, soit la distribution de la population, avec les problèmes économiques qui en découlent.

La Section historique a eu l'occasion de proposer la reproduction d'anciens documents cartographiques, ainsi que de répandre la connaissance des plus importantes collections cartographiques. Nous avons aussi reçu des contributions historiques à l'intéressant problème des variations des climats, et d'importantes propositions pour la rédaction d'un catalogue complet des différents documents cartographiques dispersés dans les bibliothèques de l'Europe, avec la reproduction des plus importants d'entre eux.

La Section pour la géographie régionale et pour la diffusion de la culture géographique nous a soumis plusieurs relations importantes

de voyageurs ayant parcouru des régions encore peu connues, en illustrant leurs traits les plus caractéristiques. Les belles monographies *Regional Studies of Great Britain*, qui furent offertes aux Membres du Congrès, méritent d'être signalées.

Une grande partie de l'activité du Congrès, à laquelle ont pris part les différentes Sections, a été représentée par les diverses Commissions de l'Union Géographique Internationale. La Carte du Monde à 1/M est en bonne voie. Les Terrasses pliocènes et pléistocènes ont été l'objet d'études préliminaires en Europe Occidentale et dans le bassin de la Méditerranée, de la part de la Commission chargée des recherches en question. On a décidé de les intensifier encore, en limitant leur champ d'action, tout en l'étendant au reste de l'Europe et aux autres parties du monde. La Commission de l'Habitat Rural a présenté des monographies importantes, et se propose d'offrir au prochain Congrès des cartes spéciales concernant les habitations et les établissements humains des divers états de l'Europe.

La multiplicité des arguments discutés est due au grand nombre de représentants de la Science Géographique intervenus au Congrès et qui ont beaucoup facilité ma tâche de Président. Je leur apporte, au nom de l'Union Géographique Internationale, mes plus sincères remercîments. L'œuvre la plus efficace a été celle du Comité Organisateur du Congrès qui a si parfaitement organisé les réunions, les faisant alterner avec de nombreuses excursions instructives; je nommerai en même temps l'ancienne et illustre Université de Cambridge, laquelle offrit au Congrès une large hospitalité, lui permettant de développer son activité dans une sereine atmosphère de paix et de recueillement. Je présente de chauds remercîments à l'Université ainsi qu'au Comité Organisateur.

Pendant les trois années de ma présidence, c'est à dire de 1925 à 1928, le nombre des Nations adhérentes à l'Union Géographique est monté de 14 à 19. Parmi les nouveaux adhérents, souhaitons la bienvenue aux États Unis d'Amérique et exprimons l'espoir de voir bientôt se joindre à nous d'autres Nations ayant déjà contribué d'une façon considérable aux progrès de notre Science. Leur entrée nous permettrait de former une seule Société, où seraient réunies les activités du monde entier dans le champ des travaux géographiques, si intimement liés à l'évolution des peuples.

L'activité des géographes de tant de différents pays, démontrée d'une façon si évidente par ce Congrès, me donne confiance dans les progrès futurs des travaux de cette Union qui s'est déjà montrée la plus fertile parmi celles qui composent le Conseil International des Recherches.

Je suis donc heureux de pouvoir transmettre nos divers travaux au nouveau Président, M. le Général Bourgeois, persuadé que, sous sa capable direction, l'Union Géographique Internationale fera de nouveaux progrès dans toutes les branches.

J'exprime ma vive gratitude aux Autorités, aux Corps Académiques, aux personnalités scientifiques et à tous les membres du Congrès intervenus à Cambridge, et je termine par les vœux les plus sincères pour la prospérité de la Grande Bretagne qui nous a offert une si généreuse et si cordiale hospitalité.

I AM glad to be able to conclude the labours of this International Geographical Congress by stating that it has marked a considerable progress in our science and in its various branches.

In mathematical geography and in the work of cartography the English school has, as always, made notable contributions to the technical work and its principles, while many other nations have in divers ways actively co-operated in this important branch of geography.

In the field of physical geography, which had already been extensively cultivated, the numerous new contributions have led to a considerable advance in the elaboration of general principles to serve as a basis in this fruitful field of investigation. I would refer in this connection particularly to the resolution concerning a detailed programme of researches in the study of climatic variations within historical times which has evoked so lively an interest among members of the Congress.

Equally valuable have been the contributions to the biographical Section which has also produced important scientific results, among them the adoption of a programme dealing with the study of fauna and flora of high mountains, which is to serve as a basis for the special Commission to be appointed by the International Geographical Union.

The ever present problems of human economic and political geography have found many contributors either to the study of the origin of human adjustment to environment or to that of the distribution of population and the economic problems arising therefrom.

The historical Section had occasion to recommend the reproduction of important ancient cartographical documents and to make known the most important cartographical collections. Historical contributions were also made to the fascinating problem of the variation of climates; and important resolutions were adopted by which the various cartographical codices scattered throughout the libraries of Europe might be collected in a complete catalogue, with reproductions of the most important among them.

In the Section of regional geography and of the diffusion of geographical culture we have heard important accounts from travellers of regions but little known at present, illustrated by views of their most characteristic features. In this connection the splendid *Regional Studies of Great Britain* which have been presented to the members of the Congress deserve special mention.

A particularly notable activity of the Congress that has occupied the various Sections is referable to the work of the three Commissions instituted by the International Geographical Union. The Map of the World 1/M is well under way. The Pliocene and Pleistocene Terraces, to the study of which important contributions have been made in the communications of that Section, have

been the object of preliminary investigations in Western Europe and in the Mediterranean Basin by the Commission appointed to deal with them. It has been decided to intensify researches by concentrating upon a common object and at the same time to extend them to the rest of Europe and to other parts of the world. The Commission on Rural Settlement has presented notable monographs on its subject-matter, and has taken a decision to prepare for the next Congress particular maps dealing with human settlements and habitations in the various States of Europe.

The Congress has been able to treat so many different subjects, thanks to the numerous representatives of geographical science who have gathered here and who have greatly lightened my labours as President. I venture to offer them my sincere thanks in the name of the International Geographical Union. The greatest help has been given by the Organizing Committee of the Congress, which has succeeded in making such perfect arrangements for its meetings and for so many instructive excursions; and also to the illustrious and ancient University of Cambridge, which has offered to the Congress that atmosphere of peace and hospitality worthy of her traditions. Our sincere thanks are due both to the University and to the Organizing Committee.

During the three years of my Presidency the nations which have joined the Geographical Union have risen from the number of fourteen in 1925 to nineteen in the present year. Among the new members we welcome the United States of America, and we entertain the hope that other countries which have had so large a share in the development and advance of our science will join our Union, so that it may form a single Society reuniting all the forces of the world for the progress of geographical science, which has so many bearings on the evolution and life of the peoples.

The activity shown by the geographers of the various nations and proved by the results of this Congress leads me to hope for the fruitful continuation of the work of the Union which has already shown itself one of the most fertile of those composing the International Research Council. I am therefore happy to hand over to the new President, Gen. Bourgeois, the whole of our many-sided activities in the certainty that under his capable leadership the International Geographical Union will progress ever further in the attainment of its aims.

In conclusion I desire to express our gratitude to the authorities, to the academic bodies, to the distinguished scientific personages, and to the members of the Congress themselves who have met here in Cambridge; and to my thanks I add my sincerest wishes for the prosperity of Great Britain which has given us such a generous and cordial hospitality.

GENERAL. 18–24 JULY

18 JULY

AIR PHOTOGRAPHY AND ARCHAEOLOGY

O. G. S. CRAWFORD

THE PRESIDENT in the Chair.

Other works: *Air Survey and Archaeology: Geographical Journal*, May 1923, LXI, pp. 342–60.

Air Survey and Archaeology: Ordnance Survey Professional Papers, New Series, No. 7, Southampton, 1928, 42 pp.

Wessex from the Air (with Alexander Keiller), Oxford, 1928, 264 pp.

19 JULY

CAMBRIDGE: THE TOWN AND UNIVERSITY

VERY REV. D. H. S. CRANAGE, LITT.D., F.S.A., DEAN OF NORWICH

REV. W. WESTON in the Chair.

23 JULY

THE TRIPOLITANIAN SAHARA

S. A. R. AMEDEO DI SAVOIA, DUCA DELLE PUGLIE

THE PRESIDENT in the Chair.

See *Il Sahara Tripolitano: L'Universo*, Firenze, Nov. 1928, IX, 11, pp. 1055–66. (In Italian, with seven illustrations and a map of Fezzan.)

MY object in reading this paper is that of giving a summary description of Tripolitania, with special regard to its desert Hinterland, which is one of the least explored and most unknown regions of Northern Africa. This description has no scientific pretensions but only endeavours to report the impressions of one who has crossed the country on military duty. The slides which accompany my account will, I hope, give a better idea of the territory and at the same time enable me to condense what I have to say. The photographs are far from perfect, having been developed and printed in the desert; and I must therefore ask my audience to regard them with kind indulgence.

Tripolitania can be said to form the Mediterranean slope of the Sahara. Its geological frame is constituted by later formations of the Secondary era, chiefly of the Cretaceous period, revealing a simple, tabular stratification, with a generally horizontal tendency, broken here and there by formations of volcanic origin. On the plateaux and

on the littoral plain the rock structure is often covered for vast and irregular tracts by aeolian and fluvial formations of the quaternary age. These soften the contours of the country and usually convey fertility to the soil. According to modern studies, chiefly based on the absence of typical evidences of drained maritime basins, the particular configuration of the desert surface is due to the disintegrating action of rain and torrential waters, combined with that of the sun and wind.

The salient features of the Tripolitanian Hinterland are the following:

The *Edeien*[1], or sandy desert, consists of immense stretches of dunes of continental or maritime origin, the forms of which vary according to the powerful action of the winds.

The *Serir*, or desert of small pebbles, is an absolutely flat country, where the hard soil is covered with small pebbles in which flint preponderates, polished and rounded by the action of wind and weather.

The *Hammada* is a desolate endless platform of rocky and stony desert, arid, waterless, with no vegetation and no fauna except the horned viper and the scorpion. These limestones and sandstones are usually of a dark red colour; hence the name *Hammada el Homra*. The rock is hard and compact, broken here and there by cracks. The heat is terrible; and the refraction of the sun, the insidious nature of the ground, and its barren, rugged aspect render these regions the most dangerous of the Sahara.

The *Mellahe* are salt-water lakes, and the *Sebche* are the dried-up beds of ancient salt lakes, in which the soil, completely sterile and perfectly horizontal, is covered with a thin layer of coagulated salt.

Finally, the *oases* are dotted like green shady islands in the immense waste of the desert.

Proceeding southward from the sea I shall glance rapidly at the geographical configuration of the country. The Tripoli plain, which extends along the coast, rises very gradually from sea level to a few hundred metres. It is wide towards the Tunisian border and becomes narrower towards the east.

To the south of the plain and approaching the sea in an easterly direction is the first ridge of steep and rugged hills, cut by the erosion of numerous *uidan*. This ridge is about 350 km. long and stretches in a north-easterly direction from Nalut to Homs. In the central part it rises to over 800 m., declining gradually towards the Tunisian boundary and eastward towards the sea. This system rises abruptly from the plain in a steep gradient, in contrast with the gentle slope

[1] The Italian spellings of most of the names have been retained.

10°
Zuara
32°
Giado
Nalut
G E B E L
GRANDE ERG
Sinauen
G. ZEKRIT
G H I B L A
Ghadames
28°
Duesa
E D E I E N
Ubari
I M A N G A S A T E N
AMSACH
ACACUS
Ghat
Tallisarhe
24°
10°


18°
32°
28°
24°
Homs
Misurata
Tauorga
Ulid
GRAN SIRTE
Sirte
S I R T I C A
Bu Ngem
EL GHEDADFA
Bu Etla
Bir Tar
Ueddan
Hon
Socna
Kessir
GIOFRA
Tegrift
Marada
Augila
Gialo
Zella
EL ES SODA
GAF EL GHARBI
GAF ES SCERGHI
Serir Ben Afien
G. RAMLA EL KEBIRA
Fugha
HARUGI ES SOD
Brak
Omm el Abid
Sebha
HARUGI EL ABIAD
Z A N
Dugiali
Traghen
Zuila
Murzuk
EL HOFRA
Uau el Kebir
Gatron
Tegerri
TRIPOLITANIA E FEZZAN
100 50 0 100 200 km.

it presents to the south, where it forms the vast plateau of the Gebel. Here the country is level again and furrowed by an infinite number of *uidan*, the majority of which descend to the Sirte, while others finish in the dunes of the great Erg. The thalweg of the wadis, nearly always dry, generally offers excellent pastures for camels and sheep. This semi-desert territory, named Ghibla or country of the south, has an approximate altitude of 400 m. Stony and undulating, it is a zone of transit for the nomad tribes who find temporary possibilities of life along the valleys of such wadis as have a subterranean waterflow.

Proceeding southward we meet a second gradient, with a direction parallel to the coast; it is the edge of the Hammada el Homra, the desert plateau which stretches from the hills of the Gebel Zekrit in the west to those of Gheriat in the east. The mean altitude of the Hammada is 500 m.; it declines gently westward towards Ghadames but falls sharply to the south in a series of escarpments until a fault marks the beginning of the Edeien. This is an immense succession of sand-dunes, alternating with Serir, which extends southwards for hundreds of kilometres.

At the eastern extremity of the Hammada there is another series of hills which stretch eastwards towards Cirenaica. They form a third gradient, characterized by the black colour of the volcanic rock, and are divided into two ranges, forming together a wide arc. The western system is called Gebel es Soda, the Black Mountain, and attains in parts the height of 1000 m. The eastern, Harugi es Sod, is of more moderate altitude.

These mountains adjoin the northern edge of the great Fezzan plateau. This stretches south-west to the Amsach and Acacus mountains, which separate it from the remote oasis of Ghat. Due south, with a hardly perceptible rise, it extends to the Tummo mountains. The Fezzan plateau also has an average altitude of 500 m. Three successive depressions traverse it in a parallel direction, each several hundred kilometres long and finishing in the area which is crossed by the ancient caravan route from Socna to Murzuk.

To complete this brief picture there remains the Sirtic region and the transverse depression which extends from the Giofra oases to those of Marada. This country is a great steppe, slightly undulating and bounded by the Gulf of the Gran Sirte to the north, by the Gebel es Soda and Harugi to the south, and by the plateaux of Tripoli and Cirenaica on either side. The Sirtic desert is generally even, except in its western and southern part where the country is broken and rugged. It slopes gently to the sea where it encounters a narrow strip

of dunes, parallel to the coast, and an abundance of wells and rich pastures. We have seen that the wadis of the Gebel as well as those of the Hammada and Gebel es Soda descend into the Sirtic desert. They do not, however, carry any surface water.

The population of Tripolitania, estimated at about half a million, is derived from two principal ethnic elements, the Berbers and the Arabs; to these are joined minor aggregations of negroes, Turks, and Jews. The Berbers constitute the principal racial element and form two-thirds of the population. In the various groups, tribes, and clans into which they are subdivided every possible mixture is to be found. The Arabs settled here definitely after the eleventh century and easily succeeded, with their superior war-like qualities, in imposing on the autochthonous Berbers their religion, their customs, and to a certain extent their language. To these groups of pure Berber race must be added the Marabut aggregations which penetrated Tripolitania following the great religious movement which occurred in the Islamic world at the end of the fourteenth century. These elements had an important rôle in uniting in one religion the invaders and the Berbers and in bringing back the latter to the land from which they had been driven in the former period of strife and violence. The strength of the above-mentioned religious aggregations is still traceable in various parts of the country. The Ghedadfa of the Sirte, for instance, and the Fergiani of Tarhuna, are the dominating tribes in their region, although pure Berbers. In other instances the fusion between the two races is complete and harmonious; and again, there are cases in which the Berbers are subordinate to stronger groups of Arabs. Another important element is the religious nobility, formed by the so-called Sherifian groups of Islam. These Arabs boast direct descent from the Prophet, and enjoyed certain privileges under former governments. Among the minor elements I may mention the Cologli (from the Turkish word meaning "sons of slaves") who originated from crossings between Judaic Berbers and Christian slaves captured by the Tripoli pirates. The negroes imported as slaves from the Sudan are now very much mixed with Berbers and Arabs. Only in some cases in the Fezzan and in the town of Tauorga on the coast there are insignificant numbers of pure negroes and mulattoes. The Jews number about 16,000 and are descended principally from the early settlers of Roman days, subsequently crossed with Berber blood. They are nearly all in the town of Tripoli and deal exclusively in commerce. Among the people of Berber origin certain tribes belonging to the Tuaregs of the north, who live in the Fezzan and on the western caravan routes

between Ghat and Ghadames, are worthy of notice. I shall return to them later in my account.

The climate of the country varies according to the different zones. The littoral has a mild climate tempered by sea winds; then come the semi-desert, the plateaux, and finally the Saharan zone. The climate of the first two is favourable to the growth of palms, olives, almonds, mulberry trees, and vines; the soil is naturally good and capable of improvement if treated and cultivated rationally. The coast and semi-desert zones are rich in subterranean waters at no great depth below the surface, which afford excellent possibilities of irrigation for agricultural purposes. The remains of ancient farm houses and colossal hydraulic works found in the remotest parts of the desert testify that the fertility of the country has considerably diminished since Roman days. The problem of improving the system of irrigation in order to restore the land to its former prosperity has been the object of serious study. Much has already been done in successfully consolidating the invading sand-dunes that threatened the existence of flourishing regions. Dunes are known to retain a large quantity of water. Rain percolates easily through the sand, which absorbs it like a sponge and prevents evaporation. Plants grow and develop rapidly in consequence with no further need of irrigation. Tamarisks, acacias, Australian mimosas and eucalyptus grow with surprising vigour on the consolidated dunes; and hundreds of thousands of these trees have been planted in the last few years.

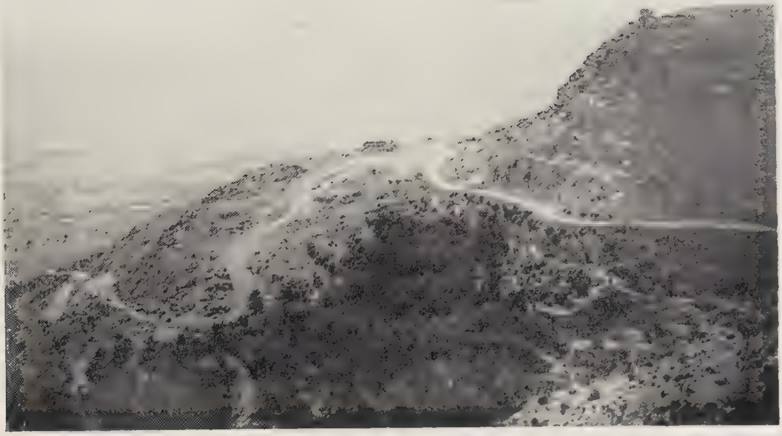
The natural means of communication are the caravan routes. Of these by far the most important are those that go from the sea to the interior and therefore towards the Sudan and even to Kano in Nigeria. The transverse routes, more or less following the parallels, which at one time were much frequented for purposes of trade and religion, are now practically abandoned. The caravan routes that lead south from the coast can be divided into three branches. The eastern branch, starting from Tripoli and passing by Tarhuna, Beni Ulid, and Socna, crosses the Gebel es Soda, descends to Omm el Abid, and proceeds to Murzuk, with an important deviation from the main route, that goes from Bu Ngem to the Sirtic coast. The central branch, from Tripoli and the Ghibla and the Hammada el Homra, arrives at the Wadi el Agial and then proceeds to Murzuk or to Ghat. Finally, the western branch joins Ghadames to Ghat and marks the western frontier of the region. These routes were at one time the arteries of Saharan trade, but their importance is steadily being reduced owing to the dying out of the slave trade, and above all to the progressive

development of rail and sea transport which affords a safer and quicker access for the products of tropical Africa to the great markets of the world.

The Fezzan country, which constitutes the real Saharan zone of Tripolitania, is perhaps worthy of a more detailed description. This remote and characteristic region is interesting because all the problems of communication between Libya and Central Africa are associated with it. To its position it owes a romantic past; as the ancient home of the proud Caramanlis it remained independent for many centuries, while the domination of Phoenicians, Egyptians, and Greeks was alternating on the coast. Only in the year 19 B.C. the Roman Proconsul Lucius Cornelius Balbus Minor, at the head of an expedition quite fantastic for those times, gained the Fezzan from Ghadames, crossing the terrible, unknown, waterless Hammada el Homra, and made it into a Roman province, under the name of Phasania. There remain everywhere, even beyond Tegerri, imposing traces of this domination that lasted four centuries, with its capital first at Garama (Germa) and then at Cillala (Zuila).

All life on the remote plateau of the Fezzan is dependent upon the three great depressions that traverse it, where good and abundant water brings fertility and where in consequence a long series of green oases and so-called gardens are to be found. The three depressions are called respectively the Wadi es Sciati, the Wadi el Agial, and the Wadi Bergiusc. Diverging from these there are several equally fertile minor depressions, the most important of which is the Hofra. Away from these wadis, water is either not found at all, or at a very great depth.

One of the best ways of reaching the Fezzan is by the caravan routes of the eastern branch. Several of these, either from Tripoli or the Sirtic coast, join at the oasis of Bu Ngem and thence proceed to the Fezzan. The monotony of this hot and low-lying semi-Saharan steppe is broken only by frequent stretches of sebka and by the beds of the wadis. Only the little oasis of Bu Ngem, rich in water although partly covered by the invading sands, offers the refreshing shade of its palm trees. In the neighbourhood there are interesting ruins of an ancient and characteristic Roman fortress, probably built to protect the caravan route; the central columns, the remains of a tower, and an inscription to Septimius Severus still exist. The caravan route passes by the wells of Bu Etla, Bir Tar, and other smaller wells of less importance. It then arrives at Socna, the most westerly of the Giofra archipelago of oases.



1. *The Gebel Plateau*

2. *Moving Sand-Dunes*

3. *Consolidation of Dunes*

4. *Between Gebel es Soda and Fezzan*

5. *Spring at Brak*

6. *Cultivation of Vegetables*

The plain of Giofra is encircled by a crescent of hills to the north, whereas the Gebel es Soda shuts it in from the south. Here certain stratifications of hematite and volcanic rocks give to these hills the aspect of lava. In this vast region the oases are scattered over rocky ground covered with stones and sebkas. These oases have a special peculiarity; although the climate is dry and very hot, they benefit by the rains often abundant that fall on the neighbouring hills. Water is often found at less than 5 m. There are various species of palms, all of which give excellent crops of dates. In their shade grow acacias, mimosas, and fruit trees, and also, in small square patches, vegetables and corn. The abundance of subterranean water allows the cultivation of cereals without irrigation. In these little havens of verdure and moisture animals labour patiently to raise the water for irrigation by the traditional, primitive method common to all the Saharan oases; there are the same goat-skin water-bag, the same rope of palm fibre, and the same slow, painful, and incessant work. Between the garden walls and the little houses, many of which have an upper storey, run small tortuous streets full of silence and shade.

The population is mixed, with a strong Berber element. The work of the fields is entrusted to liberated slaves and negroes. Generally men wear the gandura and the white burnus, and women the blue Sudanese robe. They are good-tempered, indolent, quiet, and not very religious. Polygamy is rare, and they marry young. Agriculture is better developed than trade.

Socna is the principal town. It has a rude battlemented fortress and four mosques, and is surrounded by high walls. The Arabs live all together in a special quarter. Towards the middle of the Giofra is Hon, with its white walls and the rich palm glades of Kessir. Still more to the east rises the ancient city of Ueddan surrounded by palm trees and picturesquely situated on the top of a small hill. It has a famous mosque and many Roman ruins in its neighbourhood bearing witness to its ancient splendours.

From Ueddan the caravan route departs in a south-easterly direction for the oasis of Zella, which is the centre of the caravan routes of the southern Sirtic country. From Zella there are routes in every direction—to Sebha, to Murzuk, to Uau el Kebir, to Gialo, and to the coast. I followed this last route in February during operations against rebel tribes concentrated in the Sirtic desert. It crosses the Sirtic country in its wildest part. The landscape is desolate. Here and there the monotony is broken by the so-called Virgins of the Desert, isolated outcroppings of rock on which wind and weather have left

deep traces of erosion. For days and days one walks on beds of fossil shells, while 100 km. north of Tegrift one crosses for at least 50 km. the remains of a petrified forest. Of this interesting phenomenon there are other examples in Tripolitania, in the Wadi es Scerghi, and near Benebeia in the Fezzan. They serve to demonstrate that there was once luxuriant vegetation, certainly due to the existence of periodical and abundant rains; and the shells denote probably a successive submersion of the whole region.

South of the Giofra rises the Gebel es Soda. This name signifies, as I have said, Black Mountain. No name could be more appropriate. It is a terrible desolate sea of shining black rocks without traces of life or vegetation. Peaks, fissures, rocks, cracks—all is black and tends to give an infernal aspect to the country. The volcanic origin of this system is proved by the presence of craters, by the coating of lava covering its flanks, and finally by the saline, sulphurous zone to the north of the range near Socna. There are no considerable altitudes; the highest is the Gebel Nabet Drug, which rises to 1300 m. The whole range slopes towards the south in a series of terraces, forming rocky plateaux between circular valleys, often closed by very narrow passes. Under the black strata is always found very friable, reddish yellow sandstone. The only sign of life in all this desolation is the caravan route, winding like a long ribbon over the diabolical black earth. Towards the east the hills continue, as we saw, with the much lower ranges called Harugi es Sod and Harugi el Abiad. The general characteristics of these are the same as those of the Gebel es Soda. They are crossed by the caravan route that mounts to the Fezzan from Augila and Gialo.

Descending the western slope of the Gebel es Soda the traveller meets with the beds of many wadis and reaches the hills of Gaf el Gharbi and Gaf es Scerghi, forming what the natives call the Gates of the Desert. He enters thus into the real Fezzan, the zone of Saharan oases, passing by the Serir ben Afien, which is an endless smooth plateau, formed by a compact sandy surface covered with small pebbles. Having passed the dunes of Ramla el Kebira he arrives at the first of the three great depressions. This is the Wadi es Sciati, a broad valley over 800 km. long and of an average height of 600 m. The northern edge of this depression is an abrupt scarp formed by a fault, in which the wadis have excavated deep furrows and ravines, The Wadi es Sciati has abundant surface waters which run in small streams. Agriculture is well developed, and the zone is thickly populated. Along the valley occur villages and lovely oases, such as Brak, Duesa, and Maharuga.

In the Edeien country extending between the first and second depressions and in the direction of the Imangasaten Edeien there is a flat and sandy region which from the name of its inhabitants is called the Dauada country. Ten small salt-water lakes are in this zone, which is inhabited by strange, little, black people of hideous appearance, whose uncertain origin is attributed by some to a hybrid descent from Central African negroes. These natives live on the shore of the lakes in miserable huts under the rare and scattered palms, and their food consists exclusively of the worms which they catch in the lakes and which are called Daud. The edible worms of these lakes have been studied by Dr Oudney, who lost his life in Africa. They are the larvae of a species of Dyticus and live in the soft mud at the bottom of the lakes. They are of a red or brownish colour. The natives catch them with special sacks of fibre. They are pressed and dried, then sold in cakes, and are considered nourishing and a delicacy throughout the Fezzan country.

The second of the great transverse depressions is the real heart of the Fezzan. It is crossed by the Wadi el Agial and extends to a distance of over 450 km. This long valley presents the interesting characteristics of having the greatest depression at the centre, while its bed gradually rises both eastwards and westwards. The country is mainly arid desert with the exception of the important caravan centre of Sebha, round which is a series of oases and villages. Between Sebha and Ubari there is abundant surface water which affords comparative richness and fertility to the soil. At the pass of Maknusa the smooth and polished sides of the black rock reveal very interesting old Libyan sculptures of a type and epoch identical with those discovered by Barth and Richardson in the valley of Tallisarhe in the last century. The deep cuttings in the rock represent giraffes and oxen, accompanied by inscriptions. To the west of Sebha lies Germa, the ancient Garama of the Romans, and the capital of the Fezzan province for several centuries.

Among the inhabitants of this region I may mention the Tuaregs. These veiled people of the desert belong to three divisions of the Azger tribe, or Tuaregs of the north. The customs of these proud and war-like raiders are well known. They are the real pirates of the desert; and to kill, lie, or steal is no dishonour with them, even though they are faithful to certain rules of an ancient and savage code of chivalry. The men are tall and remarkably handsome. Their endurance and ability in riding the racing camel, or mehara, are unsurpassed. Warfare and camel-breeding are their chief activities. The women are unusually beautiful. Their faces, unlike those of other desert women, are

unveiled, and their position in the family and the community is important. They practise music and literature and often hold public offices.

The third great depression of the Fezzan is formed by the Wadi Bergiusc, with the Wadi Otba and plain of the Hofra adjoining it. The broad valley extends for about 400 km. and maintains a constant altitude of nearly 600 m. The principal oases of the Wadi Bergiusc are Dugiali, Zergan and Tessaua. The last is sadly notorious on account of the massacre of the courageous Dutch woman explorer, Alexandrina Tynne, which took place in that neighbourhood in 1869. In the Hofra, which in Arabic means "the Ditch," we have Murzuk. This town was for a long time the capital of the Fezzan and owes its decadence to the enormous diminution of the caravan trade. There are numerous wells; but the water is bad and the climate is malarial. Traghen was the capital for two centuries under the Negro domination. Zuila, the ancient Cillala of Roman times, is the city of the Sherif. Beyond Zuila the depression narrows, and the northern edge becomes higher.

The Fezzan ends to the south-west with the range of the Amsach hills, followed by the Acacus mountains and another great depression trending to the south, in which Ghat and other minor oases are situated. Ghat is an independent Berber town in Targhi territory. Its importance is due to its position on the shortest and the surest trading route between Tripoli and the Sudan. Good pasturage and water, sometimes drinkable, often bad and sulphuric, interrupt the long stretches of desert between Ghat and Ghadames. In the northern part are salt marshes and sebkas.

Ghadames, the ancient Cydamus, rises on the western edge of the Hammada. An old Roman edifice contains a great fountain of tepid water, perpetually flowing. This abundant spring, that forms a picturesque little square lake, is the life and pride of the city. It is estimated to furnish 2500 litres of water per minute. The water is carried to the gardens by five principal channels, with which are connected innumerable secondary ducts. Ghadames is one of the oldest Libyan cities and was at one time densely populated. Seen from a distance it appears slightly sunken in a shallow depression, flanked by a conical hill on one side and by reddish tabular terraces on the other. The oasis is enclosed in an irregular polygon between old walls, and is subdivided into more than 200 gardens with at least 25,000 palm trees. Fruit, vegetables, green stuff, and a little barley are also grown there. The city has an interesting market, frequented by every variety

of Saharan tribe. The roofs of the houses are noteworthy for their peaked gables, which are supposed to protect their inmates from evil spirits. These houses are almost all two-storeyed. The roof-terraces are united by passages, forming a sort of secondary town, with its own markets, inhabited almost exclusively by the women. As in other Saharan cities, the streets are covered by characteristic arches, and the walls decorated with rough ornamental designs. These tortuous, shady corridors through which the life of the city flows are picturesque and mysterious in aspect. Ghadames is the last point to the north which feels the influence of Nigeria, both in architecture and in the Hausa dialect spoken by the population, which is a mixture of races, predominantly Berber. The climate is very warm and there is a great difference between the temperature of day and night. Rain is an event of the greatest rarity. It happens only once or twice in a lifetime, and then it is fatal to the fragile houses made of clay and mud.

That less well known part of Tripolitania which has formed the object of this paper ends at Ghadames. The caravan route which continues on to Tripoli, passing through Sinauen and Nalut, is accessible to any European who wishes to visit the fascinating city which the French have named Ghadames la Mystérieuse.

THE SHAKSGAM VALLEY

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COL. SIR GERALD LENOX-CONYNGHAM, F.R.S. in the Chair.

Other works: *A Journey across Central Asia: Proceedings of the Royal Geographical Society*, 1888, New Series, x, pp. 506–7.

The Problem of the Shaksgam Valley: Geographical Journal, Sept. 1926, LXVIII, pp. 225–30.

Remarks on *The Shaksgam Valley and Aghil Range: ibid.*, April 1927, LXIX, pp. 323–5.

24 JULY

MANUSCRITS PERDUS DE VOYAGEURS FRANÇAIS DES XV^e^ ET XVI^e^ SIÈCLES

M. CH. DE LA RONCIÈRE

THE PRESIDENT in the Chair.

Au Congrès de géographie du Caire, j'avais l'honneur d'exposer les résultats de mon enquête sur la Découverte, jusqu'ici insoupçonnée, de l'intérieur de l'Afrique au Moyen Age. Mais il subsistait des problèmes sur lesquels j'avais attiré l'attention de la savante assemblée.

Quatre cents ans avant l'Allemand Gerhard Rohlfs qui croyait être le premier Européen, en 1864, à explorer l'oasis du Touat, un voyageur du nom d'Antonius Malfant ou Malfante l'avait visitée et décrite. Que dis-je! Il datait du Touat même, en 1447, la relation de voyage qu'il adressait à Gênes. Quel était-il? Quel était son vrai nom, Malfant, un français, selon la signature, ou Malfante, un Italien, selon la transcription de sa lettre? Mystère.

Et le mystère s'épaississait du fait que la cartographie de la région saharienne et nigérienne était, non pas postérieure, mais antérieure au voyage de Malfante. Dès 1413, la carte majorquine de Mecia de Viladestes figurait tout l'éventail des pistes qui rayonnent autour de Tombouctou par le Soudan.

I. *Isalguier, l'explorateur du Niger*

Et tandis que le voyage de Malfante, qui était génois—des documents exhumés d'archives notariales le prouvent—ne laissait d'autre trace que le seul mot *Tuetum*, "le Touat," dans une carte génoise de 1457, au milieu d'une Libye peuplée de dragons, le planisphère bien antérieur de Mecia de Viladestes jalonnait de toute la ligne des oasis, des salines ou des massifs, Tafilelt, Tabelbert, Touat, Teghazza et Hoggar, les pistes qui menaient à Tombouctou et à Gao. De quel voyage le planisphère majorquin de 1413 pouvait-il bien être le reflet?

"Avez-vous lu la chronique du parlement de Toulouse au XV^{e} siècle? Elle contient quelque chose sur l'Afrique," me dit un jour un professeur de Tarbes, M. Lizop. Heureuse rencontre! Je tenais la solution cherchée. Le voyageur existait: c'était un Français.

En cette année 1413, l'année du planisphère de Viladestes, venait de rentrer en France un Toulousain, qui avait vécu huit ans à Gao, et qui rapportait une description des pays qu'il avait parcourus. Anselme d'Isalguier avait quitté la France en 1402; il résidait depuis 1405 à Gao, Gago, selon la chronique française dont nous allons parler, ou Kagho, comme les chroniques nigériennes appellent cette capitale. 1402 est la date où Jean de Béthencourt emmenait aux Canaries des colons et notamment des gens de la Bigorre et du sud de la France. 1405 est l'année où il fit une descente en Afrique et eut un sanglant engagement avec une grosse caravane de Maures. Il y a lieu de se demander si ce n'est pas ainsi qu'Anselme d'Isalguier parvint à Gao; car, déjà, le *libro del conoscimiento de todos los reynos* écrit vers 1350 nous l'apprend, les caravanes allaient chaque année du Seghiet-el-Hamra, proche du cap Bojador, à l'Adrar des Iforas, au nord de Gao,

où les Reguibas de la région du littoral continuent aujourd'hui encore à se rendre.

A Gao, Isalguier tomba amoureux d'une négresse qui portait le même nom que la mère de l'askia ou vice-roi de la ville. Et, bien que musulmane, il épousa Casaïs. Au bout de quelques années, il se décida à rentrer en France, ramenant de Gao sa femme, une petite fille de six ans et une demi-douzaine de nègres et de négresses. L'un des nègres, l'eunuque musulman Aben Ali, guérit d'une pleurésie le chroniqueur Bardin, dont nous tenons ce récit. Il guérit aussi le Dauphin Charles—Charles VII—qui passa cinq jours à Toulouse, non pas en 1416 comme l'a imprimé Dom Vaissète; un manuscrit, beaucoup meilleur, de la chronique de Bardin, donne: mars 1419 (vieux style), qui est effectivement la date, et la durée, du séjour du dauphin à Toulouse. Amoureux de la petite mulâtresse, qui reçut le nom de Marthe au baptême, Bardin compulsa chez Isalguier sa relation de voyage et un dictionnaire trilingue composé "ex idiomate arabico, turcico et africano," c'est-à-dire un dictionnaire arabe, targhi et songhaï, dans les trois langues parlées à Gao, avec le sens des mots en français et en latin.

Ce dictionnaire existait encore en 1702. Un érudit lyonnais, Anthelme Tricaud, déplorait qu'il restât manuscrit. La relation de voyage était au collège des jésuites de Lyon. Tricaud en a tiré des détails, plus complets que ceux de Bardin, sur le voyage d'Isalguier. Les deux manuscrits sont aujourd'hui perdus.

L'érudit lyonnais, qui eut les manuscrits d'Isalguier entre les mains, ajoute des détails savoureux, celui-ci entre autres. Un roitelet nègre éprouvait tant d'affection pour Isalguier qu'il mourut de chagrin six semaines après son départ. Comment le sut-on à Toulouse? Par une lettre peut-être. Nous savons, par Ibn Batouta, que les caravanes marocaines qui traversaient le Sahara, se faisaient précéder, plusieurs jours d'avance, par des coureurs porteurs de lettres pour retenir des chambres à Oualata. Et du fond du Touat, la lettre de Malfante ne parvint-elle pas à Gênes?

II. *Virgile, ingénieur dans l'Inde*

La vie d'Anselme d'Isalguier était un roman. Les aventures d'un autre voyageur français servirent de thème à une romancière. *Crémentine, princesse de Sanga*, est une "histoire indienne" que Madeleine de Gomez tira, en 1728, des mémoires d'un "Gentilhomme françois natif de la province de Languedoc, Georges de Virgile, chef des ingénieurs, officier général et géographe des camps et armées de

François I^{er}. Il avait fait, ajoute la romancière, une juste relation de toutes les guerres que je décris; il y avait joint les portraits et les caractères des princes dont je parle, avec le plan des villes et des lieux où ces grands évènements se sont passés." Et Madeleine de Gomez poursuit:

"Virgile, ayant les ordres secrets de François I^{er} de faire alliance avec quelque Roy des Indes Orientales, d'y former un établissement et d'y laisser des troupes en garnison, partit de la Rochelle avec deux vaisseaux, montés de trois cent cinquante hommes, ayant sous lui pour capitaines Jacques Duval et Grégoire Du Tremblay.

Il arriva heureusement aux Indes et fit sa première descente sur les côtes de Coromandel. Pour marque de prise de possession, sur une pierre fort haute, Virgile grava lui-même les armes de France. En partant de ce lieu, l'un de ses vaisseaux, ballotté pendant huit jours, fut englouti dans les flots sans que l'équipage du second lui pût donner du secours. Celui sur lequel étoit Virgile, le *Dobryego*, nom bizarre, fut échoué sur les côtes du golfe de Cambaye; tout y périt, à la réserve de Virgile et de soixante matelots ou soldats qui furent faits esclaves et menés à la ville de Cambaye où ils furent vendus."

Cambaye, ville alors florissante que célèbrent à l'envi Maçoudi, Marco Polo, Marino Sanudo, Ibn Batouta, Almeyda, était au pouvoir des musulmans qui avaient remplacé, en 1329, ses temples hindous par une mosquée d'une belle ordonnance, encore debout aujourd'hui.

C'est là qu'était esclave Georges de Virgile. "Son heureux destin le fit tomber entre les mains du satrape Bogad, gouverneur de la ville, qui faisoit bâtir un palais sur les bords du golfe. Virgile lui présenta un dessein pour élever un palais superbe à l'européenne, avec des jardins, des eaux jaillissantes, des fontaines et des cascades. Ce palais, qui subsiste encore aujourd'hui, ajoute la romancière, a été regardé comme le chef d'œuvre des Indes. Le roy de Cambaye, informé de la magnificence de cet édifice, envoya quérir l'esclave chrétien, et Virgile vint à la cour de Badur. Au roi de Cambaye, il répondit que son nom étoit Virgile, son extraction noble, sa profession les armes, son grand art le génie, et son pays la France, le plus puissant empire de l'Occident, que tous les guerriers qui étoient avec lui dans les navires du roi son maître, avaient péri sur les côtes du royaume de Cambaye, sans qu'il en fût échappé que soixante qui gémissoient dans les fers. Badur, charmé, lui fit donner une maison magnifiquement meublée" dans sa ville de "Madaban."

Le "Badur" et le "Madaban" de la romancière sont faciles à

identifier. Bahâdur Shâh, sultan du Goudjerat depuis le 20 août 1526, aussi belliqueux que sanguinaire, avait détrôné son frère Maḥmûd Shâh II, battu son autre frère Latif Khan, envahi le Dekhan, annexé le Mâlwâ.

"Madaban," sa résidence, était une ville fameuse sous le nom de Châmpânir, que l'un de ses prédécesseurs Maḥmûd Bîgaruh avait conquise le 24 novembre 1484 et à laquelle il avait imposé son nom: Maḥmûdâbâd. Les Hindous, pour ne pas laisser tomber entre les mains des musulmans leurs femmes et leurs enfants, en avaient fait un gigantesque holocauste.

De cette belle ville, aujourd'hui à demi déserte, qui dort au pied de la haute cime de Pâwâgadh, la mosquée de Jâmî Masjid, aux porches magnifiques et aux mihrâbs finement sculptés en l'an 1509, évoque seule les splendeurs d'un temps où Virgile y occupait un riche hôtel dont une marquise castillanne faisait les honneurs.

Virgile était devenu grand maître de l'artillerie. "N'ayant pas trouvé un seul canonnier qui entendît son métier," il obtint de Bahâdur la mise en liberté de tous les esclaves chrétiens, dont beaucoup étaient des artilleurs, et se donna "la satisfaction d'avoir rompu les fers d'un nombre infini de malheureux." Mais à quel prix!

Car ici, le roman peut être contrôlé. Et voici la poignante histoire des compagnons d'infortune de Virgile. Sans doute, le nom de leur vaisseau n'est pas le *Dobryego*, mais le *Grand Anglais*; et celui de leur capitaine est déformé en Diaz de Brigas. Mais à cette date, aucun autre vaisseau français n'aborda dans l'Inde. Et par ailleurs, la supplique, car il s'agit d'une supplique adressée au vice-roi portugais de l'Inde, cadre avec les données du roman.

"Trente six povres misérables chréthiens de la nation de France" se disaient victimes de leur capitaine, qui les avait dupés en indiquant, dans la charte-partie signée à Honfleur et dans le congé demandé à l'amiral de France, une destination tout autre que l'Inde, à savoir le Congo et le Brésil. Or, après hivernage à Quiloa, ils avaient gagné Diu dans le golfe de Cambaye en mai 1528. Et bien que le gouverneur de la ville leur eût envoyé en guise de saufconduit une flèche de son carquois, ils avaient été incarcérés comme pirates sur l'ordre du sultan Bahâdur.

Les Portugais avaient une factorerie à Diu. Et voici pourquoi les captifs les suppliaient de tourner vers eux leur "douche face." "Nostre Capitaine a faict la feste au Roy," disaient-ils, "il veut nous emmener avec lui au service du grant chien Bahador. Nous avons respondu, et spécialement nos bombardiés, que, en ceste terre et avec ceste

quenaillhe, nous ne voulons pas estre plus grans que nous sommes, car nous aymons myeulx vivre en povreté avec nous frères Chresthiens que de estre grans signeurs avec les ennemys de la foy. N'avons espérance que à Dieu et à vostre noble signeurye. Les povres chrétiens vous demandent pardon: c'est une vertu plus divine que humaine que de pardonner. Ne permetez pas que tant d'âmes soyent perdus et gastés en la main de ces chiens mauldítz." Le cri de détresse de malheureux "en voye de perdition" ne fut pas entendu: ils ne quittèrent les travaux forcés de la montagne de Maḥmudâbâd-Châmpânir[1] que pour servir d'artilleurs dans l'armée de Bahâdur, "après s'estre faits renégats[2]."

Pourquoi Bahâdur avait-il un tel besoin d'artilleurs? à cent mètres au-dessus de la plaine radjpoute, un long plateau est couronné d'une forteresse énorme qui développe, aujourd'hui encore, une enceinte crénelée, renforcée de grosses tours, sur onze kilomètres de circuit. Tchittor, "la petite ombre du monde, le parasol de la terre," n'est plus qu'un amas de huttes au milieu de ruines: mais quelle évocation prodigieuse de sa fortune passée sont trois cents édifices encore debout: la Tour quadrangulaire de la Renommée; les temples de la Déesse des scribes et du Dieu noir; la Tour de la Victoire, aux neuf étages décorés de tous les dieux de l'Olympe hindou, monument commémoratif d'une victoire du roi Khoumbou sur les sultans coalisés du Goudjerat et du Mâlwâ[3].

C'est de cette défaite que Bahâdur entendait tirer une revanche en attaquant, dans cette position formidable, la reine régente, "la Crémentine" du roman, qui gouvernait pour son fils Vikramagit.

Il avait rassemblé un parc de siège d'un millier de pièces, dont quatre canons gigantesques traînés par quatre cents paires de bœufs, et une artillerie mobile chargée sur deux cents éléphants, apte à repousser les violentes contre-attaques de la cavalerie Radjpoute, Mogole et Mahratte. La conduite des travaux du siège fut confiée à Virgile. Après avoir couvert le camp de solides lignes de circonvallations, il ouvrit la tranchée. Derrière des troncs d'arbres, liés de fortes chaînes, qui formaient mantelets, douze batteries furent amenées à proximité des remparts et, par un feu continuel, paralysèrent les sorties de la garnison. Deux vastes forts furent ainsi édifiés à loisir, dont les plateformes dominaient la place. Des pièces, amenées là par un escalier à double circonvolution et servies par des canonniers

[1] Supplique publiée par Sousa Viterbo.
[2] *Les Voyages advantureux de Fernand Mendez Pinto*, p. 90.
[3] Louis Rousselet, *L'Inde des Rajahs*, Paris, 1879, in 4to, p. 229.

européens, balayèrent les rues de la ville, que Bahâdur pouvait contempler lui-même du haut de ces observatoires. La garnison se fit massacrer ; la population hindoue se jeta dans les flammes d'un bûcher. Quand, en mars 1535, Bahâdur fit son entrée dans "le parasol de la terre," Tchittor n'était plus qu'une cité morte.

De l'aveu de Bahâdur, c'était aux habiles dispositions de l'ingénieur français qu'en était due la prise. Mais il manquait au vainqueur un trophée: la reine héroïque qui avait été l'âme de la défense, qu'était-elle devenue? Les officiers, mis à la torture, ne le révélèrent point. S'il faut ajouter foi au roman de Madame de Gomez, il existait dans une cachette du palais l'entrée d'un souterrain, qui allait déboucher derrière les lignes de circonvallation dans une mosquée. C'est par là que s'était enfuie la reine sous la conduite d'un vieil iman.

Virgile rendit au sultan du Goudjerat un dernier service, en construisant à Diu un mur de circonvallation pour isoler de la place la factorerie portugaise. Là, à Diu, le sultan Bahâdur venait de rendre visite, à bord de la capitane portugaise, au vice-roi Nuño d'Acunha, quand, en s'en retournant le 14 février 1537, il fut assassiné.

Bien ne retenait plus Virgile dans l'Inde. Il s'embarqua sur un navire arabe pour Suez, gagna le Caire et Alexandrie. Un bâtiment génois le porta à Constantinople, où l'accueillit M. de La Forest, ambassadeur de France. Puis il vint rendre compte de sa mission à François Ier.

Si, un jour, on retrouve ses Mémoires, qui étaient encore en 1728 entre les mains de ses descendants, il sera curieux de savoir pourquoi on l'appelait, dans l'Inde, Diaz de Brigas.

III. *Malherbe, le premier globe-trotter français*

Le troisième manuscrit perdu ne nous est connu que par un interview. Mais le reporter n'était autre que le savant Pierre Bergeron, l'auteur du *Traicté de la navigation et des voyages de découverte, principalement des François*. On comprend par là l'intérêt qu'il attachait à l'interview d'un voyageur qui avait quitté depuis vingt-huit ans la France, parcouru le Mexique et le Pérou, combattu les Patagons, gagné la Chine et fréquenté le "Tuteur de l'humanité" et le vainqueur des Turcs, le Mogol Akbar et le Shah Abbas. L'auteur de cet exploit était un Breton de Vitré, Pierre-Olivier Malherbe, le premier globe-trotter français.

Et peut-être avait-il accompli un autre exploit en écrivant le récit de son voyage autour du monde. Ici même à Cambridge, à Magdalene College, on conserve les mémoires de Pepys, secrétaire de l'amirauté

anglaise en 1660: ils sont écrits en sténographie. Je me demande si Pierre Bergeron n'entend point parler de sténographie, quand il décrit le manuscrit de Malherbe comme "d'amples mémoires de plus de huit cents feuilles de papier, en notes et chifres connuz de luy seul. Les hauteurs et élévations des païs et villes, les meurs, façons de faire, religion, armée, justice, fertilité, température," bref, toutes les données de la géographie physique et humaine y étaient scrupuleusement notées.

Malherbe avait quitté Vitré à treize ans, en 1581, pour aller s'établir, en compagnie d'un de ses oncles, à San Lucars de Barrameda. Devenu à moitié espagnol—ne signait-il pas "Pedro Lopez Malaierva, mercader breton!"—il avait gagné le Mexique et découvert dans le Nord une riche mine d'argent, dont il fut dépouillé par Mendoza, vice-roi de la Nouvelle-Espagne. Ébloui du monceau d'or et d'argent qu'il avait vu à Panama, dans la chambre du Trésor, et qui n'atteignait pas moins d'une trentaine de millions, il avait été à la source de ces richesses. Il était descendu dans la mine d'argent de Potosi, mine sans fin où l'on s'enfonçait de plus de cinq cents brasses dans les profondeurs de la terre. Quelques années de séjour au Pérou en firent un prospecteur émérite ou, pour employer les termes du temps, un "grand minier et métallier."

Il allait être, au cours de ses voyages, admirablement servi pour développer ses connaissances en minéralogie. Malherbe avait pris passage au Pérou sur un navire en partance pour la Chine: soit ignorance du pilote, soit typhon, le navire dériva vers le détroit de Magellan, où de gigantesques Patagons livrèrent bataille aux matelots espagnols envoyés à l'aiguade, mais laissèrent deux prisonniers entre leurs mains. Après escale aux Philippines, Malherbe aborda à Canton. Il y demeura trois mois, le temps de noter, dans cette ville aux "habitans innumérables," la richesse du trésor impérial, où lingots d'or et d'argent en forme de pains s'entassaient dans un château-fort: la curieuse coutume de couper et de rogner la monnaie d'argent obligeait à porter sur soi des ciseaux et un trébuchet-balance. Malherbe savait observer: il méritait bien le qualificatif d'*yeux de chat* dont les Chinois gratifiaient les Européens: et que d'observations devait contenir son manuscrit, à en juger par son interview: l'emploi des oiseaux pour pêcher ou des canards pour sarcler les rizières, la coquetterie féminine qui acceptait la torture de l'emprisonnement des pieds dans des chaussures trop étroites, la complication de l'écriture chinoise aux quarante mille caractères...ne lui avaient pas échappé.

Par la Cochinchine, le Cambodge, le Siam et le Pégou, notre Breton

gagna l'Inde. L'empire colonial des Portugais reposait sur des bases bien fragiles. A Malacca, la garnison ne dépassait pas soixante hommes. A Goa, Cochin, Diu, Calicut, la discipline était des plus lâches; la soldatesque avait mis en pièces les statues et les emblèmes de Vasco da Gama, sans que les magistrats ou les officiers eussent le courage de sévir.

Au Bengale, à Lahore et à Agra, Malherbe fréquenta la Cour d'un des princes les plus remarquables qu'ait eus l'empire mogol. Akbar était le grand Khan d'un immense territoire qui n'avait d'autres limites que la Chine, le Pégou, le Coromandel et la Perse. La langue en usage à la Cour était le persan. La légendaire cloche d'argent, qui pendait au palais de Charlemagne à la portée de tout opprimé, était au palais de Lahore une réalité: "après des procédures sommaires et verbales, souvent même devant le prince," l'exécution de la sentence avait lieu sur l'heure: "les plus grands seigneurs étaient fustigés de fouetz à plaques d'airain." Le coupable convaincu d'adultère était écrasé sous le pied d'un éléphant.

Devenu le familier d'Akbar, au point d'entamer avec lui des discussions religieuses et de lui faire admettre l'excellence de la doctrine chrétienne, "en toutes choses morale, excepté en ce qui est de n'avoir qu'une femme," le Breton assista souvent au dîner impérial. Le service était fait par des femmes; debout, sur deux rangs, elles se passaient en silence les plats de main en main. Dans la grande ville mouvante qu'était la Cour—car le Mogol avait conservé de son origine "Tartaresque et nomade" l'habitude de loger sous la tente—Malherbe avait l'occasion d'admirer chaque jour la relève de la garde. Akbar levait le doigt, et aussitôt un triple cordon de troupes entourait le pavillon impérial, gardé par des batteries d'artillerie: près de lui veillaient les "verges d'or," plus loin les "verges d'argent," et en grand'garde "les verges rouges," gardes du corps de moindre qualité. Le Breton touchait, comme sportule, de petits sacs d'or qui constituaient sa pension sur le Trésor Mogol.

En carrosse tiré par d'agiles *bœufs de carrière*, qu'on nourrissait de farine et de cassonnade en guise d'avoine, il gagna le Thibet, "le grand Tabé," que de longtemps les Européens ne devaient plus revoir, et s'achemina ensuite vers Samarcande, ville "non guères moindre que Paris." Le palais du Mogol y avait un revêtement de marbre: et dans la grande rue des marchands, l'éclat des pierreries se mariait aux couleurs chatoyantes des étoffes de soie. Aux écoles de la ville, florissait la philosophie d'Aristote, dont un Tartare de Samarcande devisait plus tard à Rome avec le cardinal Duperron.

Le long du Gange, entre deux croupes d'une montagne, gisait une mine de diamant dont une porte de fer fermait l'entrée. Autorisé à la visiter, Malherbe assista à l'extraction du minerai. Un filon grisâtre, de quatre doigts d'épaisseur, était broyé à coups de marteau sur des billots recouverts de cuir. De là, sortaient les magnifiques diamants si renommés du Grand Mogol, tels, le fameux *Koh-i-noor*, "la montagne de lumière," qui des trésors du Grand Mogol à Lahore a passé dans les joyaux de la Couronne d'Angleterre. En descendant le Gange, "dans le pays de Chingara," il y avait d'autres pierres précieuses, des rubis femelles plus ardents et plus claires que les mâles, des spinelles que notre Breton n'eut pas le temps d'aller reconnaître.

Malherbe, à la mort d'Akbar en 1605, devint le favori du fils Djahanguir, "le Conquérant du monde," comme il l'avait été du père. Il l'accompagna dans une expédition contre le roi du Goudjerat, qui tenait au sud de ses états une péninsule montagneuse et qui, sur son roc d'Ahmadabad, défiait le Conquérant du monde. Que pouvaient contre son repaire les éléphants de guerre, qui fonçaient, gavés de sucre et échauffés par du poivre, à travers les armées adverses, en renversant tout sur leur passage! Aucune sommation ne l'intimida. Mais quand l'étendard rouge, après l'étendard noir, lui eut signifié qu'il aurait une guerre sans merci, les obusiers commencèrent à tonner, "des pièces courtes d'artillerie, la gueule en l'air, de façon que leurs énormes boulets retombaient à plomb sur les édifices du chasteau." La ville fut bientôt en ruines, et le roi de Goudjerat, forcé de capituler, fut mis à mort.

Lesté d'un passeport "en arabic" notre Breton s'achemina vers la Perse, où le Shah Abbas l'accueillit avec cordialité. Il eut pension sur le trésor, audience de la reine; et il lui fallut une certaine force d'âme pour ne point se laisser enliser dans les délices où le conviait le shah, en le pressant d'épouser une de ces "Persiennes" d'Ispahan qui, par des "inventions de voluptéz et délices estranges, ensorcelaient les hommes." A Ormuz, pourtant, il ne fut pas insensible aux charmes de la belle Fatima, fille du roi indigène, dont un collier de magnifiques perles encadrait la beauté.

A Bagdad, en territoire turc, Malherbe fut moins heureux; le pacha le dépouilla "de tout ce qu'il avait le plus beau." En Arabie Déserte, le roi l'accueillit dans sa capitale d'Avisa, arrosée par des canaux dérivés de l'Euphrate. D'Ana, la ville la plus commerçante du pays, le Breton gagna sur des chevaux arabes pleins de fougue la ville d'Alep et la Méditerranée. En 1608, il revoyait le pays natal et venait offrir à Henri IV ses services et le fruit de son expérience: "il s'offrait

d'estre luy mesme le conducteur de ceus qu'on voudrait envoier par mer à la descouverte de certaines mines d'or et d'argent de l'Inde Orientale." Et pour intéresser la reine Marie de Médicis à ses projets, il lui faisait présent d'un chapelet en dents de Néréides, auxquelles on attribuait une vertu curative lors des accouchements. Parmi les échantillons qu'il avait rapportés, était un minerai de couleur azur pailleté d'or, qui fut soumis à l'examen d'un "personnage excellent en la métallique, Chymie et autres secretz de nature": et ce fut un bel objet de dispute entre Malherbe et Vaillant.

Le Breton ne put obtenir qu'on s'intéressât à ses découvertes. Déçu, il reprit la route de l'Espagne, en emportant la précieuse relation manuscrite de ses aventures. Mais renseigné par lui, un orfèvre bordelais du nom d'Iriaste allait se rendre à la Cour du Grand Mogol Djahanguir où il construisit le fameux trône du Paon.

Des voyages français dont j'ai exposé le thème, que possédons-nous pour l'instant? Pour Anselme d'Isalguier, le reflet d'une carte, pour Georges de Virgile, un roman, pour Olivier Malherbe, un interview. Une critique objective nous a permis de contrôler l'existence de leurs relations. Sont-elles à jamais perdues? J'espère fermement que non. Il subsiste encore, dans des archives de famille, bien des documents de ce genre. N'avez-vous pas, en Angleterre même, le manuscrit inédit d'un peintre français qui accompagnait Francis Drake dans son voyage autour du monde! Permettez-moi d'exprimer le souhait qu'au prochain Congrès International de Géographie, ces trésors ensevelis dans l'oubli voient la lumière et qu'ils forment une suite aux grands recueils de voyages d'Hakluyt et de Ramusio.

PHYSIOGRAPHY OF THE ATLANTIC COAST OF NORTH AMERICA

PROF. DOUGLAS W. JOHNSON

Other works: *Shore Processes and Shoreline Development*, New York, 1919, 584 pp. *The New England-Acadian Shoreline*, New York, 1925, 608 pp. (Many articles in periodicals.)

In eastern North America the old rocks of the Appalachian Mountains and Canadian Shield, lifted well above sea-level and deeply dissected by stream erosion, are bordered on the east by a broad band of low-lying sandy coastal plain deposits of much more recent age. In late Tertiary or Pleistocene time a differential warping of the continent carried the northward part downward at least 1200 ft. below its former

level, thus permitting the sea to flow clear across the sandy coastal plain belt and come to rest against the older and more deeply dissected rocks to the west. Such is the origin of the two strongly contrasted types of shore-line scenery described in this paper. South of New York the sea still rests against the low coastal plain, giving a simple shore-line characterized by sandy bars, shallow lagoons and broad coastal marshes. North of New York the sea has reached the older rocks, and there is a sudden change to the rocky, irregular coast where bold peninsulas and countless islands alternate with deeply indented branching bays. Here the low coastal plain is found under the sea, forming the famous fishing banks of the continental shelf.

Apparently this major differential submergence towards the northeast is only one of several, perhaps many, oscillations of level which affected the coast in recent geological times. There is general agreement among American students that our exposed coasts record repeated changes in the relative levels of land and sea during the Pliocene and Pleistocene periods. Along the bleak borders of Labrador, the deep embayment of the St Lawrence, the rock-bound coast of New England, and the sandy shores of the coastal plain stretching from New Jersey to Florida and around the margins of the Gulf of Mexico, are found elevated terraces, cliffs, and bars of sand believed to mark former levels of the sea. These ancient strands are found at a great variety of altitudes, from 10 or 20 ft. above present sea-level, up to 300, 400, 500 ft., and, more rarely, at still higher elevations. The lower terraces are in general the best preserved, the higher being more dissected by erosion. Not infrequently the coastal terraces can be correlated with terraces in adjacent river valleys, while these river terraces can be traced far up the streams, especially in the weak formations of the Coastal Plain province, until the more resistant crystalline rocks of the Piedmont Belt are encountered. Even in the narrower valleys of the crystalline province variations in valley form have occasionally been correlated with coastal terraces supposedly of marine origin.

Throughout this same long stretch of coast the evidences of geologically recent submergence are equally apparent. From Labrador and farther north, to Texas and farther south, every part of the coast is characterized by drowned valleys. In Florida, limestone caverns, believed by some to have been formed above sea-level, are now found beneath the surface of the ocean. Deposits of glacial origin in New England have been dissected by rivers, then covered by the sea. Forests rooted in glacial deposits are now found many feet below high

tide. The salt marshes afford indubitable evidence that they were formed during a slow, progressive submergence of the land in post-glacial time. I have made hundreds of sections through these marshes, from south-eastern Canada to Florida, and have everywhere found abundant confirmation of the theory of Mudge, later emphasized by Charles A. Davis, that the marsh deposits were continuously built up to high-tide level just as rapidly as the land sank or the sea rose.

There is evidence that the emergences represented by coastal and river terraces, and the submergences represented by drowned valleys, submerged forests, and submerged high-tide marsh deposits, alternated with each other. Thus the coast of Maine shows marine clays of glacial age deposited in the drowned valleys of an older landscape. In these marine clays river valleys of a later generation were carved, and to-day these later valleys are partially submerged beneath the sea. Obviously the land was above sea-level when the older valleys were carved. It was submerged when the marine clays of glacial age were deposited. It was again exposed as dry land when the second generation of valleys was carved. And still later submergence was required to drown these valleys. Other evidence, not yet fully worked out, suggests that still more complicated oscillations of level occurred; but on this point there is, perhaps, less general agreement.

It is precisely when we begin to analyse the detailed evidence of geologically recent changes of level along the American coast, and on the basis of this evidence to establish a clear chronology of past events, that serious difficulties present themselves. Included in the volume of evidence supposed to indicate former marine action at higher levels are many observations of doubtful validity. On the rocky coasts of New England and Acadia are seaward-facing cliffs, well above present sea-level, occasionally showing notches or caves at their bases, and not infrequently associated with isolated rocky pinnacles resembling marine stacks or chimneys. On the basis of such phenomena some authorities have inferred a series of former sea-levels now elevated 1000 or even 1500 ft. above the ocean surface of to-day. I have examined the best examples of these supposed marine features and find that they are in part the result of glacial plucking of jointed crystalline rock, in part the product of normal sub-aërial weathering since the glacial epoch. As I have described these features with some fullness in a volume on *The New England-Acadian Shoreline*, I shall not burden you with a further analysis here. Suffice it to say that the phenomena in question occur at all possible levels, in sheltered localities which could in no case have been exposed to vigorous wave

attack, and at elevations far above the upper marine limit as generally recognized by American geologists on the basis of delta deposits, marine clays, and well-preserved marine shells.

It is equally true that widely distributed submarine platforms, found along the shores of south-eastern Canada and the north-eastern United States, have been accepted by geologists and geographers as wave-carved abrasion platforms or marine benches, cut at or near the present sea-level. Because a detailed study of other parts of the Atlantic coast seemed to offer convincing proof that the sea had not remained at its present level long enough to carve platforms of any breadth, I was led to examine these supposed marine forms with much care, both by means of projected profiles of submarine surfaces, and by field studies of portions of platforms raised above sea-level or exposed at low tide. These studies, described at length in the volume earlier referred to, seemed to establish the sub-aërial origin of the forms in question, and thus to prove that erosion features fashioned by running water above sea-level have by submergence been carried below the ocean surface.

When we turn our attention to the river terraces, similar difficulties are encountered. Fairchild and others have accepted such terraces as locating former sea-level surfaces. But when river terraces have been employed for this purpose, sufficient attention has not, apparently, been given to the possibility that some of the terrace levels so used are determined fortuitously by rock barriers, in the manner described by Davis, and hence quite without relation to any controlling sea-level. Flint has recently presented evidence indicating that some of the terraces of the Connecticut valley, which Fairchild used in determining a supposed former marine surface, were produced in a temporary glacial lake well above sea-level.

It is evident, therefore, that while there are undoubted elevated marine terraces along the Atlantic Coast of North America, some of them associated with marine deposits containing marine shells, the history of sea-level changes which they record is at present badly obscured by a mass of fictitious indications of shore phenomena which in reality have nothing whatever to do with marine forces or marine levels. Similarly, while there appear to be river terraces properly to be correlated with former sea-levels, there are undoubtedly a great number of river terraces which have no significance whatever in studies of sea-level changes. To discriminate the true evidence from the false by a mere study of the literature seems to me an impossible task. What are seemingly the clearest examples of elevated shore-lines

as described in published reports often prove upon critical field examination to be sub-aërial forms unrelated to the sea. The student of sea-level changes, who relies upon the bibliography of his subject in extending to distant regions conclusions reached in a given locality, is treading upon dangerous ground. He will find records of supposed elevated marine forms at various levels sufficient to support any hypothesis he may hold; but grave doubt must be entertained as to the validity of conclusions reached in this manner. Only when such conclusions have rigidly been checked by personal observations at a sufficient number of points throughout the field covered by the study, can they merit acceptance by cautious investigators of this difficult subject.

While in eastern North America the separation of true from fictitious evidences of sea-level changes has not been completed, there seems to be evidence that the present position of elevated coastal terraces, and of river terraces related to former sea-levels, is chiefly due, not to shifts of the sea-level, but to differential movements of the continental mass. If, as seems probable, shifts of sea-level have actually occurred, they appear to be obscured by much more important movements of the land. I have previously shown that the coastal plain topography of the south-eastern United States can be followed downward towards the north until it disappears completely under the sea. In the south the coastal plain is broad, and but little of it continues under the sea to form a narrow continental shelf. Northward the plain narrows as it becomes progressively more and more submerged, while the submerged portion forms a correspondingly broader continental shelf. Finally, off the New England and Acadian coasts, the entire coastal plain is found below sea-level in that exceptionally broad part of the continental shelf known as the "banks" or "grand banks." Studies of the submarine topography of the banks show that the normal sub-aërial forms of the coastal plain are preserved deep under the waters, where hills and valleys are clearly traceable, and prove a differential tilting of the land mass which, while leaving the southern part of the plain high above sea-level, has carried the northern part at least 1200 ft. lower, under the sea. Studies of the outer edge of the continental shelf confirm this conclusion; for this edge is at very moderate depths off Florida, becomes progressively more deeply submerged to the northward, finally reaching its maximum depth off the New England-Acadian coast. The date of this differential warping of the land mass can be fixed in general terms by faunal evidence, and falls within the Pliocene and Pleistocene periods.

Local studies of marine and river terraces at various points along the Atlantic coast seem to show that they have been affected by this and other differential land movements. Along the shores of the St Lawrence a 20-ft. terrace described by Goldthwait has, by myself, been found at one place to descend gradually below sea-level to a depth of more than 50 ft., in the space of a few miles, thus indicating an apparent warping of very pronounced character. Goldthwait has recently shown that elevated shore-lines present in some parts of Acadia are absent in others, due to land movements in Pleistocene and recent periods. Coleman, Daly, Kindle, and other workers agree in recognizing a differential warping of the elevated shore-lines of eastern Canada. In Maine the post-glacial upper marine limit has been studied by various geologists, and there seems to be general agreement that land movements have raised the former shore-line unequally.

Nor are these evidences of land movement restricted to the glaciated area. Along the coast of New Jersey I have observed a terrace which rises towards the north and descends gradually under salt marshes farther south. Salisbury found evidence of still more marked tilting of early Pleistocene marine deposits in this same region. According to McGee, Darton, and Shattuck, the Pleistocene terraces of Pennsylvania and Maryland are inclined. Later work on some of these terraces, and especially on the coastal terraces of Virginia and states to the south, indicates that their inner margins are more nearly horizontal, permitting tentative correlations over broad areas. On this point further detailed study will be necessary before final conclusions and definitive correlations can be offered. In Texas at least five terraces of Pleistocene and recent age are found, although not all students of the region agree as to the marine origin of all of them. According to Deussen they represent successive shore-lines, some of which have been uplifted irregularly by differential land movements. Thus the inner margin of the Realitos terrace rises from an elevation of 250 ft. in the north to 520 ft. farther south, while the Torrecillas terrace is even more strongly warped, rising from 425 ft. in the north to the great altitude of 870 ft. in the south.

Where river terraces have been correlated with changes of level, they seem to show the same evidence of differential land warping. This is particularly true in the case of the Pleistocene river terraces of Texas described by Deussen. Corresponding terraces on different rivers are found at very different altitudes above the present stream beds. Thus the Uvalde terrace, one of the older and more dissected members of the series, is 132 ft. above stream-level on the Guadalupe

River, 220–280 ft. on the Colorado River, and 310 ft. on the Brazos River. Some terraces found on the Guadalupe River are not found at all on the Colorado and Brazos, this being due to the fact that the region traversed by the Guadalupe experienced warping which did not extend to the other regions.

It thus appears that while coastal and river terraces in eastern North America require further study before the sequence of terraces can fully be established and before correlations between distant areas can be made with assurance, the trend of the evidence is indicated with some definiteness. It points to the conclusion that differential land movements have played a major rôle in depressing former shore-lines below present sea-level in some places and raising them to varying altitudes above sea-level in others. This does not preclude the possibility that eustatic changes of sea-level have also played a significant rôle in the history of the changing sea margin; but it does make it very difficult to isolate changes due to movements of the sea from those due to movements of the land, or even to evaluate the extent, if any, to which sea movements have been of real significance. For the present we can only say that the physiography of the north Atlantic coast, in the present incomplete state of our knowledge, appears to offer no confirmation of the theory that eustatic changes of sea-level have played a major rôle in the formation of coastal and river terraces along the borders of the continents. It is equally true that the American evidence does not necessarily negative the theory as applied to the west European coast, since it is at least theoretically possible that the European land mass may have enjoyed a long-continued stability which enabled it to record evidences of sea movements now lost or confused on the restless shores of America.

There is one terrace on the American coast which has seriously been attributed to a recent eustatic shift of sea-level. This is the so-called 20-ft. terrace best described by Goldthwait from the shores of the St Lawrence estuary, and which Daly has identified with other terraces from 8 or 10 to 30 ft. or more above sea-level in various parts of the world, and which he explains on the theory that sea-level has recently dropped 20 ft. I have examined typical portions of this terrace on both the north and south sides of the St Lawrence, and have found evidence which throws doubt not only on the supposed uniform position of the terrace above sea-level, but even on its marine origin. It is, in fact, but one member of a series of terraces bordering the drowned valley of the St Lawrence River, some of which are still to be observed at various elevations above sea-level, while others have

been discovered through a study of the submarine topography by means of projected profiles. Apparently it is quite as logical to argue that one of the submerged terraces proves a recent *rise* of sea-level, as it is to say that one of the still exposed terraces proves a recent *fall* of sea-level. The problem requires further study, but it seems quite possible that the series of St Lawrence terraces will prove to be river terraces against which the sea has recently come to rest, owing to a subsidence of the land. In this connection it is significant to note that the so-called 20-ft. terrace is best developed and broadest in the narrow, inner part of the estuary, where wave action has been extremely weak or practically absent; whereas in the broad parts of the estuary, where the shores are exposed to vigorous wave attack, the terrace is narrow or wholly lacking. Whatever its origin, it does not appear always to maintain a horizontal position above sea-level. On the south side of the estuary, in the vicinity of Isle Verte, it is possible to trace what has been described as a portion of this terrace from an altitude of but a few feet above sea-level to a depth of more than 50 ft. below the sea, as mentioned earlier in this discussion. It would seem, therefore, that the theory of a 20-ft. marine terrace along the St Lawrence due to a recent fall of sea-level rests on a foundation of uncertain strength.

Daly has assembled a large amount of data from widely different localities in support of his theory. I am not prepared to question these data in so far as they relate to foreign shores, although I believe there are certain dangers which appear to be inherent in Daly's method of procedure. For the eastern coast of America, however, I can perhaps speak with some assurance. The evidence appears to be abundant and conclusive that the last movement was not one of emergence, as implied by Daly, but one of submergence. Sections through the salt marshes show that they have gradually encroached upon the upland; that is, the land sank or sea-level rose, and the movement was slow enough for the high-tide grasses, such as *Spartina patens*, continuously to build up the marsh surface to high-tide level, and thus to keep pace with the progressive submergence. The evidence seems equally clear that this movement of submergence ceased several thousand years ago, perhaps one to three thousand years before the Christian era, although the time cannot be fixed with any degree of precision. No trustworthy evidence of emergence since the period of marsh-building has been discovered. There are, indeed, various forms along the coast which have been interpreted as marine terraces, and in elevation some of these fall within the rather broad limits—8 or 10 ft. up to 30 ft. or

more—which Daly accepts as sufficiently close to be valid evidence in support of his theory of a 20-ft. terrace due to a recent eustatic shift of sea-level. But these forms appear to be of diverse origins and of widely different ages. Some are believed to have been carved in hard rocks prior to the glacial epoch; others are cut in glacial deposits. All of them clearly antedate the most recent change in sea-level, which, as already indicated, was in the opposite sense to that inferred by Daly. The proofs that the last movement was one of submergence appear not only on the northern part of the coast, near to and north of the former ice margin, but far south along the coastal plain of the southern states. Seemingly this coast lends little support to the theory of a recent 20-ft. drop in sea-level.

Finally, I would suggest certain considerations which seem to me worthy of attention when we turn to the literature of sea-level changes in search of support for any particular theory. Once we admit the possibility that land movements may have elevated former shore-lines to varying heights above sea-level—and surely the evidence from many parts of the world forces us to admit such possibility—we must frankly face the peculiar difficulties which confront the student desirous of discovering and analysing evidences of independent, eustatic shifts of sea-level where these are believed to exist. It is inherently improbable that a given coastal area, both landward and seaward from the shore-line, will always be carried uniformly upward. Experience teaches us that oscillations of level have been of very frequent occurrence in past geologic times. Warpings of the earth's surface, in which some parts rise and others fall, seem to be a normal form of earth movement. There is no reason to expect that the axis of warping should remain for ever constant in position; and, if it does not, the zone through which it shifts must alternately rise and fall. If the theory of isostatic adjustment of segments of the earth's crust has even a foundation of truth, then the coastal zone, lying between the land masses which suffer erosion and rise and the sea-bottoms which receive new deposits and sink, must be of all places the zone of most uncertain behaviour. That the axis of tilting, between the rising land and the sinking sea-bottom, should coincide exactly with the irregular shore-line, is in the highest degree improbable. If it crosses the shore-line at one or more points, segments of the shore seaward of the axis must experience progressive submergence, while intervening segments, lying landward of the axis, are slowly raised above sea-level. Now let the axis shift but slightly, as seems a most probable occurrence, and conditions are suddenly altered for parts of the shore. If

the shift be seaward, all areas previously rising will continue to rise; but areas previously suffering submergence will reverse their movement and begin to rise also. If the shift be landward, areas formerly rising will begin to sink. There seem to be good reasons for believing, on *a priori* grounds, that the coastal zone has been a zone of exceptional instability, and that the shore-line has migrated alternately backward and forward over the uneasy coastal belt. Under the conditions stated, it is evident that some parts of the shore must be raised more than others, some parts submerged more than others, and that oscillations of land-level have been not infrequent. The physiography of the Atlantic coast of North America appears to harmonize with some such history of events as is here predicated.

Now note the difficulties which confront the student of eustatic shifts of sea-level on such a coast. Having found at one place a well-defined marine terrace some 20 ft. above sea-level, he seeks for evidences of a similar strand at approximately the same level elsewhere. On a coast which has experienced repeated oscillations of land-level he is almost sure to find what he seeks. Here is a strand 14 ft. above sea-level, yonder a bench 25 ft. high, and far to the south another rising 17 ft. above the sea. Knowing that the original terrace levels must vary to some extent with variable range of tide, difference in exposure to waves, and other physical factors, he feels justified in accepting these several elevated shore-line remnants as parts of a single strand, and he finds in their nearly uniform elevation above sea-level proof that this strand was left in its present position by a eustatic drop in the level of the sea. Yet, could he but read the history of the past, he might discover that the 14-ft. shore-line was genetically identical with other shore-line remnants raised to a height of 140 ft. in more distant localities; and that the 25-ft. bench formerly rose 70 ft. above sea-level and had been carried downward to its present position by a more recent subsidence of the land; while the 17-ft. terrace was carved in rock before the glacial period, later sank beneath the sea, and only in the recent period had been carried upward to its present level by a broad up-arching of the land. Unfortunately, the remnants of successive strands, even when of different date, do not bear with them a clear record of their past histories. Thus even the most careful student finds it beyond his power to trace the true succession of shore events. Often the most that he can do is to maintain an open mind, hospitable to all interpretations not clearly excluded by the evidence before him, while he writes across the pages of Nature's incomplete and baffling record the one word: *Ignoramus*.

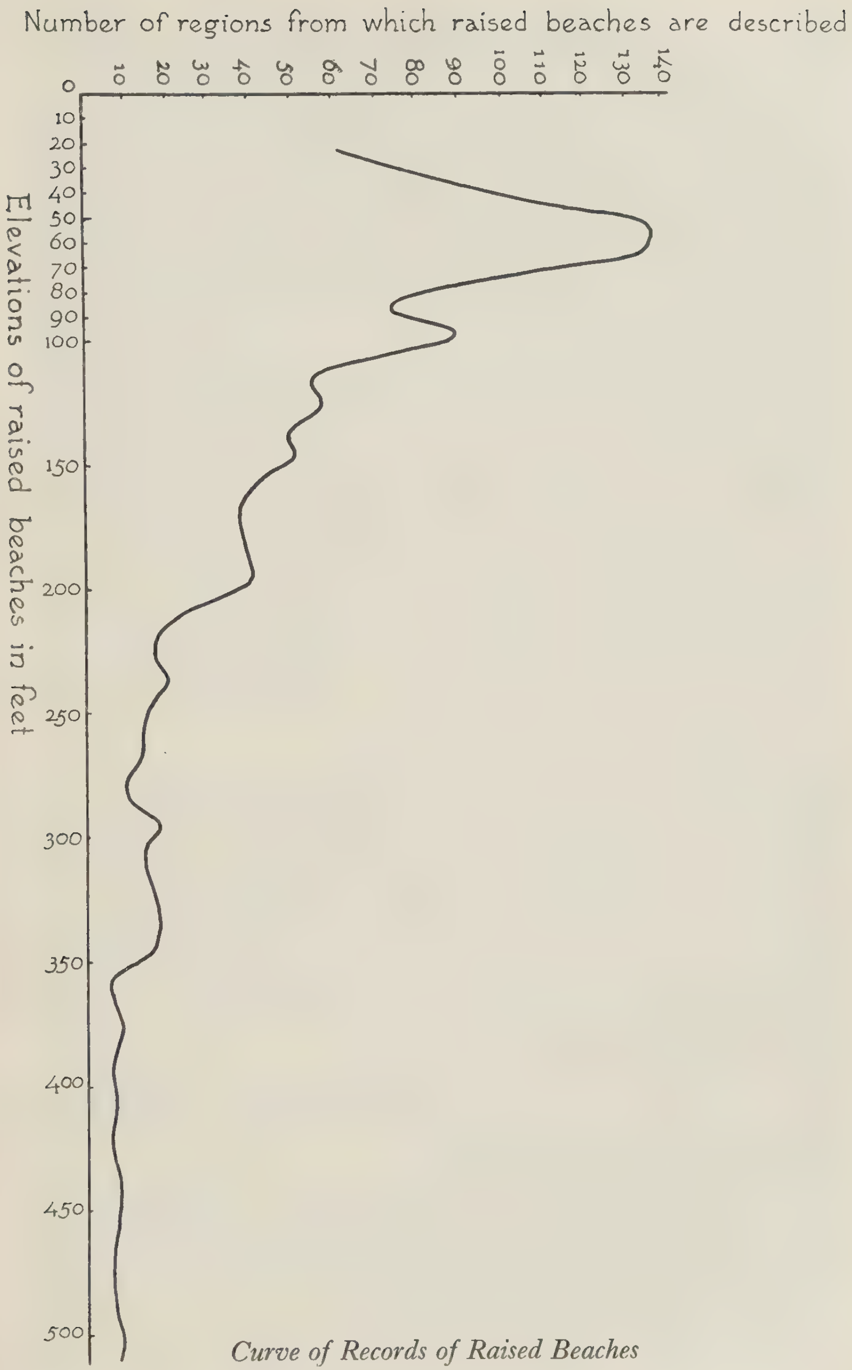
If the problem of correlating elevated strands of distant localities

be difficult *in the field*, what shall we say of the task of making such correlations on the basis of records of raised shore-lines found *in the literature* of the subject? Remember that the number of records of elevated shore-lines at various levels is extremely abundant, as should be anticipated for the uneasy coastal zone with its oscillating sea margin; that the literature contains many records from lands known to have been subjected to warping and differential tilting in Pleistocene and recent times; that the published accounts of raised shore-lines seldom give evidence sufficient to fix with accuracy the age of the forms described; that there are undoubtedly included accounts of terraces now at similar altitudes above sea-level which were formed at widely different times and which have experienced very different histories; and that the record is further confused by the inclusion of many accounts of supposed shore features which were in fact formed well above sea-level by sub-aërial agencies. Under these conditions we may blindly select at random almost any elevation under 500 ft., and find in the literature records of real and supposed raised shore-lines matching it with sufficient closeness to lend fictitious support to the theory of a eustatic shift of sea-level of the amount represented by the figure selected in this random manner.

We may estimate the degree of danger inherent in this method of investigation by plotting in tabular form all elevations of raised beaches recorded in the literature easily available. On the assumption that slow earth movements have caused differential warpings of coastal zones and consequent oscillations of sea margins, the resulting tabulation should show a well-graded series of observations from the highest to the lowest levels above the present sea surface. The farther up we go in the column the smaller should be the number of localities recorded as showing high-level raised beaches, both because warpings of maximum amplitude are rare as compared with those of slight amplitude, and because those beaches raised highest by slow emergence will usually be older, more nearly effaced by erosion, and hence less readily recognized by the observer, than those recently raised but slightly above sea-level. Thus if we search the literature for records of 20-ft. terraces we are sure to find an abundance of such records from many widely separated localities, and may draw conclusions in favour of a recent world-wide eustatic sinking of sea-level on evidence in appearance strong, but in reality altogether inconclusive. On the other hand, records of 200-ft. terraces will be found to be much fewer in number, those of 400-ft. terraces still fewer, while records up to 1000 ft. and higher are comparatively rare.

The tabulation is affected by one important factor which concerns

directly the problem of the supposed recent 20-ft. eustatic shift of sea-level. So far as has yet been shown, the 20-ft. records should be the most abundant of all, unless indeed we look for records of beaches raised only 10 ft., which might, on grounds previously cited, be expected to occur in still greater abundance. A curve or graph may be plotted by using as ordinates the total number of localities recorded in the literature as showing raised beaches at successive elevations, and as abscissae the respective elevations themselves, such as 10, 20, 30, 40 ft., and so on. We might expect such a curve to be fairly regular, with its highest point at the 10-ft. ordinate, thence descending with reasonable regularity (although of course minor inequalities or variations are not excluded and indeed are to be expected) until it reaches its lowest point with the rare records of very high terraces. But here a new element enters. Raised beaches close to present sea-level are seldom recorded in the literature, partly because the observer is often uncertain whether they may not represent forms carved at high tide or during exceptional storms, partly because cliffs so close to the shore and benches sloping continuously down to present water-level do not even attract his attention, partly because the lowest terraces are in the literature grouped together under some such expression as "other terraces at still lower levels," with no elevations specified which could be used for statistical purposes. These observations apply with peculiar force to the 10-ft. terraces, but in considerable measure also to 20-ft. terraces, and even to those at somewhat higher elevations. Thus the St Lawrence valley has long been a great study-ground for elevated shore-lines, and there is a fairly voluminous literature on the subject. Yet the most strongly marked terrace in the whole region, 20 ft. above sea-level, remained practically unnoticed until discovered by Goldthwait, one of the last investigators to enter this field. Evidently, then, we must expect our plotted curve to begin moderately low with the low-level terraces which are less frequently recognized and described; to rise sharply to a maximum for those elevated shore-lines which are high enough to be easily recognized as undoubtedly above the present reach of the sea, yet low enough to be abundantly developed and well preserved; and finally to descend progressively as higher and higher shore-lines are represented by fewer and fewer recorded examples. This expectation has fully been realized in a curve plotted by one of my graduate students, Miss Olga Kuthy, on the basis of hundreds of records of raised beaches assembled by her from the literature describing a large number of different regions. In this curve repetitions of records of the same raised shore-line are eliminated



Curve of Records of Raised Beaches

by plotting, not the number of *references* to a 20-ft. shore-line for example, but the total number of *localities* from which a 20-ft. shore-line is reported. From the curve it appears that records of shore-lines approximately 20 ft. above present sea-level are, just as might be expected, fairly widespread; also that records of shore-lines at 50–60 ft. are much more abundant and widespread; and that shore-lines of still higher levels are progressively more and more infrequently observed. In other words the frequency of shore-line records at different levels as set forth in the literature appears to be just what we would expect if the raised shore-lines observed and recorded were all due to land movements and none of them to eustatic shifts of sea-level. This does not, of course, mean that none of the shore-lines recorded was related to a eustatic shift of sea-level. But it does mean that the world-wide distribution of raised shore-lines at a great variety of levels is more favourable to the theory that differential land movements are in large measure responsible for the present position of elevated shore-lines. It also means that grave doubt must attach to any theory of a eustatic shift of sea-level based on the fact that there are in the literature many records of raised shore-lines at any given altitude. If we had sought proof of a eustatic shift of sea-level amounting to 50–60 ft. instead of 20 ft., we would have found far more supporting evidence in the literature than exists for the 20-ft. change.

In concluding this part of my discussion, I wish to repeat that I fully recognize the possibility that evidences of eustatic changes of sea-level may exist and may be decipherable. It seems inevitable that glaciation and deglaciation must have lowered and raised the level of the sea. I wish only to emphasize these three points: on the Atlantic coast of North America the evidence, as yet incompletely analysed, seems to point toward the conclusion that any features due to eustatic shifts of sea-level have been masked by far more important movements of the land; that the physiography of the coast does not lend much support to the theory of a 20-ft. terrace due to a recent world-wide sinking of sea-level; and that the method of seeking in the literature of shore-changes support for any theory of eustatic changes of sea-level is open to grave danger.

I have earlier pointed out that the last movement along the Atlantic coast of North America was one of submergence, an encroachment of the sea upon the land. Much interest has been attached to the question as to whether this submergence, or "subsidence of the land" as it has generally been termed, is still in progress. A majority of those who have studied the problem believe that in submerged stumps, rapid

wave-erosion, certain tidal records, and other lines of evidence they have proof that the land is gradually sinking, the estimated present rate of subsidence usually varying from 1 to 2 ft. per century. But I believe that all the supposed evidences of modern subsidence of the Atlantic coast of North America can readily be explained without assuming any general change in the level of either land or sea within historical times. Some of the submerged stumps indicate a real change of level, but a change which occurred several thousand years ago. Others are the result of local changes due to a variety of causes; for Nature has many ways of producing this phenomenon. Rapidity of wave-erosion depends on many factors besides progressive subsidence, and cannot safely be appealed to as a proof of changes of level. There is no doubt that at many points along our coast the sea has recently encroached upon cultivated fields, invaded forests, and broken through dykes built to keep out the tides. Settling of marsh and silt deposits when dyked and drained is a well-known phenomenon which may adequately account for an increasing difficulty in keeping the sea out of dyked areas; but an important factor in causing local encroachments of the sea which has not received the attention it deserves is found in local changes in tidal range due to changes in the form of the shore.

During the great storm of 1898 the sea broke through a bar at Scituate, Massachusetts, freely invading a bay which was formerly connected with the sea by a narrow and tortuous inlet. Under the old conditions the tides in the bay never rose as high as the ocean high-tides; and forests grew down to the lower high-tide mark round the bay shores. Following the storm the ocean tides entered the bay freely through a direct and broad channel, and the plane of mean high-tide in the bay was raised a foot or more. Salt water invaded the forest, and to-day you may find dead trees and submerged stumps all about the shores of this bay, apparently proving coastal subsidence but really showing only the effect of a local rise in the high-tide plane due to changes in the form of the shore.

The Scituate case is the key to many examples of apparent subsidence and apparent emergence found abundantly on any irregular tidal coast where waves and currents are constantly changing shore forms. Certainly on the Atlantic coast of North America local fluctuations of the high-tide surface due to local shore changes will explain a large proportion of the supposed proofs of modern coastal subsidence. But in reply to this argument some of my colleagues have pointed out that there are one or two places on our coast where tidal

records seem to indicate that mean sea-level is higher than formerly, and they have contended that however much the high-tide level may vary with changes in shore form, the mean sea-level plane is not subject to these fluctuations. This led me to analyse the factors controlling mean sea-level, and as a result of this study I several years ago advanced the theory that along an irregular coast mean sea-level is an irregularly warped and highly sensitive plane which varies in altitude with changes in the form of the shore. To test this theory the Committee on Shoreline Investigations of our National Research Council arranged for a co-operative tidal study in New York waters with the support of the U.S. Coast and Geodetic Survey, the Department of Docks, and the Department of Plant and Structures of New York City, and certain individuals. Three standard automatic tide-gauges have been installed in Jamaica Bay, New York, and a fourth at Fort Hamilton in Lower New York Bay, so disposed as best to reveal local differences in the altitude of mean sea-level due to local physiographic conditions. This particular locality was chosen as a test case because the Bay is small, the inlet comparatively large, the amount of fresh water draining into the Bay very small, and other conditions are favourable to a very slight distortion of the mean sea-level plane. It is believed that under these conditions the observed differences in mean sea-level will be very small, at most a very few inches and probably only fractions of an inch[1].

When due consideration is given to the marked variations of mean sea-level over periods of years due to astronomical and meteorological causes, and to local variations of mean sea-level due to shore changes, it is found that we have no tidal records on the American coast which show any progressive rise of sea-level or subsidence of the land. On the contrary, these records, properly interpreted, show an apparent absolute stability of our coast during the last quarter of a century; while physiographic evidence found in the position of the bases of marine cliffs long abandoned by the sea, in successive beach ridges built by the waves in the same horizontal plane, and in other coastal features, proves that there has been no appreciable general change in the relative level of land or sea during the last few thousand years.

[1] Since this was written the study has been completed. It demonstrates that mean sea-level at all three stations in the Bay is higher than outside, while the sea-level surface in the Bay itself is inclined perceptibly. The observed differences at the three stations were: ·72 of an inch, ·84 of an inch, and 2·04 in.

PRÉSENTATION DU RAPPORT SUR L'EXTENSION DES RÉGIONS PRIVÉES D'ÉCOULEMENT VERS L'OCÉAN*

M. LE PROF. EMM. DE MARTONNE

* Par Emm. de Martonne et L. Aufrère: *Union Géographique Internationale, Publication No.* 3, Paris, 1928, 200 pp. avec une Carte à 1 : 50,000,000.

Other works: *Extension des Régions privées d'Écoulement vers l'Océan: Congrès Internationale de Géographie, le Caire*, Avril 1925, Tome III, pp. 25–50.

L'Extension des Régions privées d'Écoulement vers l'Océan: Annales de Géographie, Paris, Jan. 1928, XXXVII, pp. 1–24.

Regions of Interior-Basin Drainage: Geographical Review, New York, July 1927, pp. 397–414. (In English.)

SECTION A. 19–24 July

19 July

THE "TOURING CLUB ITALIANO" AND ITS GEOGRAPHICAL ACTIVITY

PROF. G. BOGNETTI

Printed in Italian and English (*Milano*, 1928), *and read by Prof. Bognetti in Italian.* Presented to Congress.

Abstract

If the T.C.I. has the honour to take part in the Italian National Geographical Committee and to be present at this Congress, it is principally due to its having accompanied the activity more strictly related to touring—tours, camping, information, exchange of triptychs, cruises, legal consultations, sign-posts, training schools for hotel workers, protection of monuments and landscapes, etc.—with another form of activity, that is, the propagation of geographical knowledge, attained by the almost invariably gratuitous distribution to its members of various publications such as maps, atlases, guides, annuals, and, finally, by the publication (September 1927) of the International Atlas, of which we here briefly outline the origin and the leading features.

It was in 1917, whilst the great European war was still raging, that the President of the T.C.I., Luigi Vittorio Bertarelli—who had created for the service of the Touring Club a Cartographic Institute and had acquired there a long experience favoured by special aptitudes—proposed the publication of a large atlas that might range with those already in use (Stieler's, Debes', Andree's, *The Times*, Schrader's, etc.), emulating them as to comprehensiveness, but embodying certain improvements suggested by long experience.

The preliminary studies were made by Bertarelli in collaboration with one of the most appreciated Italian geographers, Olinto Marinelli, Professor at the Royal Institute of Higher Studies in Florence; sad to say, he, like Bertarelli, died a few months before the work had been completed.

The fundamental criteria of the two collaborators—of whom, one, Bertarelli, had the general superintendence of the work, the other, Marinelli, the scientific control, afterwards joined, on the technical side, by the head cartographer of the Touring Club, Pietro Corbellini—were submitted to public discussion at the Italian Geographical Congresses held at Florence (1921) and at Genoa (1924). They

received the unanimous approval of the geographers assembled at these Congresses, many of whom gave their scientific and practical contribution to the compilation of the Atlas. Finally, the Atlas was presented to the National Geographical Congress (Milan, 1927), gaining the approbation of those present and earning for the Touring Club the gold medal for merit conferred by the Ministry of Public Instruction.

CHIEF FEATURES OF THE ATLAS

The Atlas is composed of 170 plates, size 50 × 60 cm., with 130 small development maps. Of the 170 plates—some of them grouped in twos or threes—52 are physical or analytical maps, 118 are "fundamental" maps; 10 are devoted to the earth as a whole, 74 deal with Europe, 21 are devoted to Asia, 16 to Africa, 41 to America and 8 are reserved for Oceania.

Physical maps. In these maps are shown for the most part the physical features of a region. The map of the Alps is a good example. In the designing of this as many as 117 sheets, drawn to a larger scale, were analysed and checked.

General maps. Some of these maps are devoted to particular phenomena, as, for instance, sea and overland communications, ethnography, etc.; but the greater part deal with an entire region of primary importance (France, England, Germany, Spain, etc.). In these maps the geographical names are indicated, in the Italian edition, in the Italian language, where the corresponding name exists; whereas, in editions intended for distribution abroad, the geographical names will be in the respective language of the foreign country for which the particular edition is intended. Some of these foreign editions are already in course of preparation whilst others are projected.

The scales of these analytical maps vary from 1 : 30,000,000 to 1 : 3,000,000.

Fundamental maps. These maps are on a larger scale, as a rule twice that of the corresponding general map. They indicate the geographical name in the language of the country to which they refer or the language of the dominating country, as in the case of Colonies: in other words, in the language officially adopted in the respective country and used for the official publications, railway time-tables, etc.

Small development maps. These are drawn to a larger scale and reproduce particularly important sections—*e.g.* the zone of Mont Blanc, the Bernese Oberland, Canary Islands, Central Scotland, Suez and Panama Canals, Central Pyrenees, the Ruhr—as well as the plans of 192 towns and their surroundings, intended to give prominence to

the various formations and to the various distribution of the larger inhabited centres, but drawn with such clearness and precision that the individual elements may easily be observed.

Projections. Mollweide's projection is used in only two maps for the ways of communication; for the other maps, the azimuthal equivalent of Lambert and the modified conical projection of De l'Isle have been used, the latter for maps on larger scales. In this manner great homogeneity has been attained, facilitating comparisons between the various maps of surfaces and distances.

Place names of the countries not having an alphabet with Latin characters. Where there exists already an official transcription (as in Japan), this has been adopted; where not, the transcription of the names has been made according to the international conventions (London, Royal Geographical Society II System, 1921).

Sources, notes, conventional signs. Every plate is preceded by a prospectus in which are indicated the chief sources which have served for its compilation, the characters used, and their approximate correspondence, where absolute precision is not possible, with the II System or Italian phonetics—or, in the case of the foreign editions, with the phonetics of the country for which the respective edition is intended—the general terminology, abbreviations, classification of inhabited centres, conventional signs and characters.

Economy of space. A special study has been devoted to the saving of space by avoiding the repetition of sections already comprised in the other plates, by using the uninterrupted expanses of sea for inserting development maps, etc., so that the total surface utilized may be considered as exceeding that of the other well-known atlases hitherto published.

Index of names. The index comprises some 200,000 names, rarely duplicated, so that it can be considered the most complete of its kind. Every name is followed by references to the plates, so arranged that it is possible to trace it within a space of a square centimetre.

Legibility. One of the most important requisites for an atlas is that whilst being dense with names these should be easily legible. This object was attained by using for the orography a light hatching instead of a heavy shading, and by not overcharging the colours, and above all by giving particular attention to the neatness of the engraving and printing. The latter was executed by a Milan establishment, Messrs Ricordi & Co., a firm already known in all the world for its musical publications—rotary two-colour machines being used.

Classification of the inhabited centres. The greater or less importance

of the inhabited centres is indicated by the variety and largeness of the characters. The estimation of such importance is attended by many difficulties. It has necessitated long study and the weighing of many factors. The graduation was not based simply on the number of inhabitants or administrative classification or commercial importance or historical fame, but all these and other elements besides helped in deciding this question.

Editions of the Atlas. Two editions have as yet been published, representing in all twelve thousand copies, and a third edition is in course of preparation. The one presented to the Congress is the second, into which have already been introduced corrections of some inevitable oversights and several alterations and additions necessitated since the first edition to bring the Atlas up to date. The editions which will follow—and they will follow in quick succession, as each edition will be restricted to a limited number of copies—will be under the scientific control of a Commission of Italian Geographers who will keep in touch with their foreign colleagues, with the precise object of having the Atlas always up to date. The Commission is presided over by Gen. Count Carlo Porro, Senator of the Kingdom and Member of the Touring Club Council.

COL. SIR C. CLOSE said that he had had the opportunity of using and studying this Atlas for several months and that he was glad to have the opportunity of testifying to its excellence. It was artistic and clearly printed, and it was a real pleasure to consult it. It had the great merit that, as an International Atlas, the names were printed as spelt by the countries to which they belonged. Its admirable index of 200,000 names was never at fault. An excellent feature was the list of sources of information printed at the back of each sheet. He had had many occasions to use it since he became President of the Royal Geographical Society, and had found it of the greatest value. It therefore gave him the greatest pleasure to congratulate the "Touring Club Italiano" very heartily on the production of such an admirable work.

THE NEW ATLAS OF EGYPT

HUSSEIN SIRRY BEY

Presented to Congress. See *Annexes to the Report of the Egyptian Delegates to the Geographical Congress, Cambridge*, 1928. *No.* 1. *Survey of Egypt*, 1929.

Abstract

The Atlas, which has been specially prepared for the Congress, by desire of His Majesty the King of Egypt, aims at presenting as clear a conspectus as possible of present-day knowledge concerning the orography, geology and meteorology of Egypt, together with the leading facts concerning its economic geography.

The orographical map on the 1/M scale represents the first serious attempt to contour the entire surface of the country. A comparison of the orographical and geological maps appearing in the Atlas with similar maps previously published shows the great advances that have been made in recent years in geographical knowledge concerning Egypt. This rapid progress is mainly due to the use of motor-cars instead of camels for transport in the deserts.

Recent surveys have led to two unexpected discoveries of great importance. The first relates to the water supplies of the Libyan Desert where the static water-levels of the existing water-sources, apparently, form points on a gently curved underground surface, the contours of which can be drawn without reference either to the surface relief or to the geological structure. This working hypothesis permits the selection of suitable sites for new wells in regions devoid of water. Two excellent wells have already been sunk.

The second discovery is that of the Qattara Depression, a great natural excavation embracing 18,000 sq. km. of area below sea-level. This depression, the discovery of which is due to Dr Ball, presents great potentialities as a source of hydro-electric power, being capable of producing 200,000 kw. The investigation of a definite project for the utilization of the Qattara Depression and the study of the numerous engineering problems which arise are being carried out by the Survey of Egypt.

In the meteorological section of the Atlas the whole of the Nile basin is included in the maps, which are based on the records from 58 meteorological stations (27 in Egypt and 31 in the Sudan) and from nearly a hundred other stations at which only rainfall is observed.

The maps and diagrams which form the economic section are chiefly concerned with the distribution of population and the areas and values of the various agricultural crops.

Two facts, prominently brought out by these maps, are, first, the deficiency of cultivation and population in the northern parts of the Delta, and secondly, the much greater value of the perennially irrigated lands of Upper Egypt as compared with the basin lands. Both these facts emphasize the great need for further irrigation works.

MR A. R. HINKS said that he had heard for several years from friends in the Survey of Egypt of the great efforts that were being made to complete the projected Atlas in time for this Congress, and he was very glad to add his felicitations on the triumphant completion of their task. All geographers would enjoy studying the Atlas. At this moment he would speak only of Sirry Bey's reference to Egypt's contribution to the Geodetic Arc of the 30th Meridian. At the meeting of the Geodetic Union at Praha last autumn there had been much discussion of the method by which connection might

be made between the sections of the arc in Africa and in Europe. It was now generally agreed that spectacular methods involving photographic observations of rockets or lights in airships should be discouraged. The modern tendency was to take triangles where they were wanted; and here the best solution was to take a circuit of geodetic triangulation round the Eastern Mediterranean. He hoped that, as a result of this meeting, it might be possible to confirm the conclusion tentatively adopted at Praha: and that the geodesists of Italy, Yugoslavia, Turkey, Syria and Palestine might agree to complete the circuit, of which Egypt had already finished her share.

MARCHESE R. ASTUTO DI LUCCHESI added, in reference to the declaration made by Hussein Sirry Bey as to the impossibility until now of filling in the blanks west of the boundary with Cyrenaica, that the Government of this Colony was in a position to supply the necessary data for all the region stretching from the Gulf of Sollum to the Oasis of Jaghbub—as far as the route called Masrab Jalu. He would ask the Italian Colonial Secretary to give instructions to the Government of Cyrenaica to put themselves into direct touch with the Survey Department of Egypt for this purpose.

GEOGRAPHIC IMPORTANCE OF COASTAL SURVEYS

COLONEL E. LESTER JONES

Abstract

Coastal surveys are of basic importance since they relate to the meeting place of land and sea and serve as a starting-point for both interior and ocean surveys. In the case of the United States of America surveys have steadily improved to meet the needs of mariners, and this was the first scientific activity of the nation. The surveys of the continental area, of Alaska, and of the Hawaiian and Philippine Islands have been in themselves an important geographical contribution.

The need for co-ordination of surveys has resulted in the adoption of uniform standards of accuracy in triangulation over practically the entire continent.

Not only has other important scientific activity of the Government developed from the work of the Coast and Geodetic Survey, but its magnetic surveys have also covered the entire country and have resulted in similar work in many other regions, carried out by the Carnegie Institution of Washington.

Coastal surveys have proved to be important factors in the development and prosperity of Alaska and the Philippine Islands, with consequences of interest to the student of economic geography. Recently developed scientific methods of obtaining soundings and the position of a surveying vessel by acoustic methods are rapidly reducing the unsurveyed area. The tides affect the actual position of

the shore-line and they also serve to establish planes of reference to which heights of lands and depths of waters are referred.

The shores and the adjacent waters out to the edge of the continental shelf are regions of important geological activity including the deposition of sediment and earthquake activity.

Coastal surveys for the first time in the history of the earth make it possible accurately to determine changes in portions of the earth which are especially subject to change.

"THE MAP OF THE KARAKORAM"

CONTE C. CALCIATI

"Il Karacorùm" secondo le ultime esplorazioni, con speciale riguardo al contributo degli Italiani (1 : 500,000). *Istituto Geografico Militare, Firenze*, 1928. Presented to Congress.

Abstract

La nuova carta del Karacorùm che ho l' onore di presentare a questo Congresso, fu da me compilata per raggiungere un duplice scopo: (1) riunire in un unico documento d'assieme, alla scala del 500 mila, tutti gli sparsi ed eterogenei documenti topografici riguardanti la catena del Karacorùm, frutto del lavoro delle varie ultime esplorazioni venute a mia conoscenza, (2) mostrare quanta parte le spedizioni italiane, o italiani al servizio di spedizioni straniere, hanno avuto nel contribuire alla miglior conoscenza di questa bella ma lontana e difficile regione, dove l' Italia non conta nessun interesse materiale. A questo proposito mi permetto di far notare che su 19 documenti appositamente elencati in ordine cronologico in calce destra della carta, ben 7 sono dovuti ad Italiani!

Queste copie non rappresentano ancora l' edizione definitiva. Il lavoro cartografico è dovuto alla ben nota abilità dell' I.G.M. di Firenze, e posso aggiungere che, salvo pochi casi, il raccordo dei vari documenti tra di loro si ebbe in modo soddisfaciente per la ragione che tutti i varii esploratori basarono i propri rilievi sui punti principali circostanti della triangolazione indiana.

Naturalmente la carta va considerata piuttosto come un semplice schizzo, risultato di prime esplorazioni e di rilievi in parte spicciativi. Ma ho voluto che, con un diverso sistema di disegno, la carta dicesse al primo colpo d' occhio quali sono le alte zone già percorse e meglio esplorate, e quali le ignote o poco note.

Per la grafía dei nomi ho cercato di adottare, per quanto possibile, quella del nuovo Atlante internazionale del T.C.I.

20 JULY

EDWARD WRIGHT AND MERCATOR'S PROJECTION

A. R. HINKS

Abstract

Mercator gave only a very vague account of the method by which he spaced the parallels of his famous projection. The first table of "meridional parts" or their equivalent is that sent by Edward Wright of Caius College to Blundevile and printed by the latter in his *Exercises* in 1594. Wright published his table for every 10′ of latitude in 1599 in his *Certaine Errors of Navigation corrected*, and the table for every minute in the second edition of 1610. The accuracy of these tables was examined, and an attempt made to estimate the accuracy of Mercator's construction, the importance of Wright's theory, and the justice of the complaint against Hondius. If it were not for Hondius' frank acknowledgment that he had borrowed from Wright, one might have supposed that he had followed Blundevile. The paper concluded with a biographical note on Wright and examination of the suggestion that he had been one of Drake's captains in the expedition to Cartagena in 1586.

MR E. HEAWOOD, as a member of Wright's College, expressed his pleasure at hearing this appreciation of Wright from one so qualified to deal in the mathematics of the subject as Mr Hinks. In connection with the history of Mercator's projection he mentioned that there seemed a possibility that the idea of the projection had been current even before Mercator's time, as shown by the discovery a few years ago of a compass by Erhard Etzlaub of Nuremberg, with a small map on the outside of the box constructed apparently on the same principle. He also mentioned that a single sheet of a woodcut edition of Mercator's Map of 1569 had been lately acquired by the Royal Geographical Society.

THE TRANSVERSE ELLIPTICAL EQUAL-AREA PROJECTION OF THE SPHERE

COL. SIR CHARLES CLOSE

See *Ordnance Survey, Professional Papers, New Series, No.* 11. *London, H. M. Stationery Office*, 1927.

The original elliptical equal-area projection of the sphere was devised by Prof. C. B. Mollweide, of Halle, in 1805. In this projection the whole surface of the sphere is represented as an ellipse, of which the E.–W. axis is twice the length of the N.–S. axis. The parallels are straight lines parallel to the major axis, which represents the equator. The meridians are ellipses. The meridian 90° distant from the adopted central meridian is a circle.

In the transverse projection the Poles, instead of being at the extremities of the minor axis of the ellipse, are placed on the major axis.

If λ_1 is the latitude of any point with reference to the original Pole, L_1 the longitude with reference to the original initial meridian, λ_2 the latitude with reference to the new Pole, L_2 the longitude with reference to the new meridian,

$$\text{(i)}\quad \sin \lambda_1 = \sin L_2 \cos \lambda_2,$$

$$\text{(ii)}\quad \sin L_1 = \sin \lambda_2 \sec \lambda_1.$$

These quantities λ_1, L_1 are computed for any value of λ_2, L_2, and the co-ordinates plotted on the original Mollweide projection. The following tables give the rectangular co-ordinates of the Transverse Mollweide Projection for latitudes and longitudes spaced at 15° intervals.

Table for use in plotting the transverse elliptical equal-area projection of the sphere.

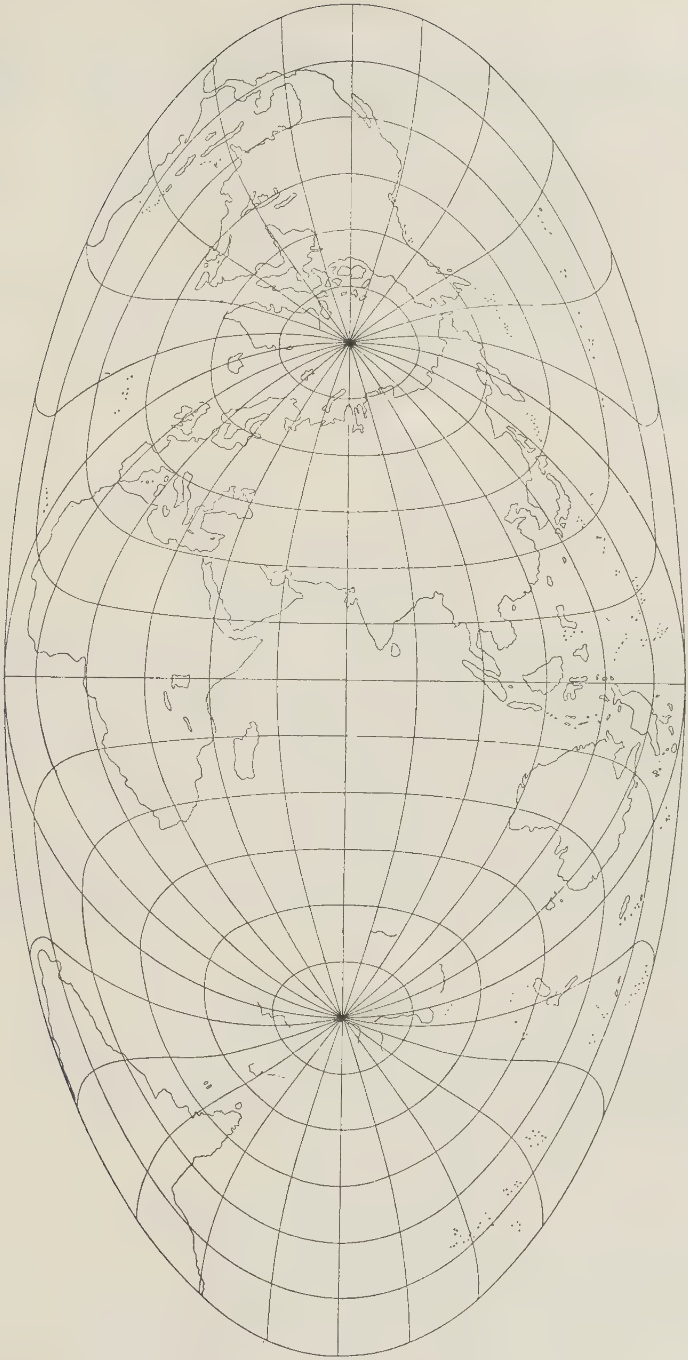
The radius of the central circle of the projection is taken as unity.

LATITUDES		LONGITUDES 0°	15°	30°	45°	60°	75°	90°
90°	y	0	0	0	0	0	0	0
	x	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000
	x^1	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000
75°	y	0	·0520	·1020	·1440	·1770	·1980	·2050
	x	·8333	·8372	·8502	·8747	·9065	·9376	·9790
	x^1	1·1667	1·1590	1·1400	1·1035	1·0615	1·0225	·9790
60°	y	0	·0970	·1980	·2810	·3470	·3890	·4040
	x	·6666	·6699	·6904	·7232	·7671	·8330	·9150
	x^1	1·3334	1·3200	1·2700	1·1970	1·1090	1·0070	·9150
45°	y	0	·1440	·2800	·4040	·5030	·5680	·5920
	x	·5000	·5055	·5232	·5561	·6087	·6896	·8060
	x^1	1·5000	1·4730	1·3950	1·2740	1·1195	·9545	·8060
30°	y	0	·1770	·3460	·5030	·6350	·7270	·7620
	x	·3334	·3346	·3513	·3763	·4217	·5016	·6470
	x^1	1·6666	1·6334	1·5250	1·3515	1·1245	·8705	·6470
15°	y	0	·1980	·3890	·5670	·7270	·8520	·9060
	x	·1666	·1688	·1760	·1902	·2150	·2668	·4230
	x^1	1·8334	1·7893	1·6660	1·4560	1·1570	·7770	·4230
0°	y	0	·2047	·4040	·5920	·7624	·9061	1·0000
	x	0	0	0	0	0	0	0
	x^1	2·0000	1·9576	1·8295	1·6118	1·2942	·8463	0

The x and x^1 co-ordinates are measured along, or parallel to, the major axis of the ellipse.

The x co-ordinate is for the longitude given in the table.

The x^1 co-ordinate is for 180°—the longitude given in the table.



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The following additional co-ordinates will be found useful in plotting the meridians 105° and 120° away from the central axis:

Meridian	105°	...	...	y = ·8990
Latitude	5°	...	...	x^1 = ·7880
Meridian	105°	...	...	y = ·8800
Latitude	10°	...	...	x^1 = ·7685
Meridian	105°	...	...	y = ·8150
Latitude	20°	...	...	x^1 = ·8065
Meridian	120°	...	...	y = ·7460
Latitude	10°	...	...	x^1 = 1·1865

In all cases the centre of the projection is the origin and the major axis of the ellipse is the axis of x.

THE POLYCONIC AS A WORLD MAP

G. T. McCAW

1. *Introductory Remarks*

A map for geographers postulates a geographical end. However platitudinous this statement may appear, it nevertheless embodies a truth. Thus, a cadastral map is, in general, of little use to a geographer. Topographical maps are of much greater value, even when not intended for purely geographical purposes; as geographical subjects become more specialized, specialists will doubtless look for larger scales. Nevertheless, it appears generally true that maps made by surveyors for their own purposes will not usually meet the requirements of the geographer, if only by reason of scale, and that maps on large scales (1/50,000 or over) will be used by geographers for intensive study alone.

These remarks are not intended to imply that, in general, the modern geographer is interested in atlas maps alone: far from it. But they do imply that, since the needs of the surveyor, the views of the cartographer and the demands of the geographer do not always coincide, the geographer may have to consider that framing for the map which is most suitable for his own study.

Here at once it may be said that the writer claims no competence to suggest the most suitable framing for geographical maps, and he realizes fully that the same framing will not suit all geographers. Malte-Brun said many years ago that the first object of the geographer who wants to frame a map should be to determine its nature and its end; and to-day the end is more varied than it was 70 years ago.

Some geographers are chiefly interested in very small scales, covering very large areas, such as continents or oceans. World maps (mappemondes) are required by a few, and of these some would insist on correct representation of area. The present paper is limited to atlas or wall maps intended for general purposes; and, even then, it considers maps of a certain category only, here classed under the general name of "polyconic," though this denomination can be applied to some of them by right of courtesy alone. Finally, the last limitation must be stated: it is not proposed to deal with maps which are in any sense discontinuous within the hemisphere, however useful these may be.

2. *Old Forms of Polyconic Map*

Polyconic projections which are so called by courtesy only may receive brief mention. Apparently the first projection of this nature was introduced in 1645 by Father G. Fournier, S.J. Suppose the circumference of a circle, named the "principal meridian," to represent longitudes 90° east and west of the vertical diameter, which marks the "central meridian," while the horizontal diameter indicates the equator. Suppose also that upwards and downwards from the equator the central and principal meridians are each divided into, say, nine equal parts, each part representing 10° of latitude, north and south; and that through each group of three corresponding points thus obtained a circle is drawn to represent the parallel of that latitude. Suppose, further, that the meridians are ellipses whose major axis is the vertical diameter and whose minor axes are fixed by terminals which mark equal division of the equator in units of 10° of longitude. The Fournier projection exhibits then that suggestion of spherical framework which is still often used to illustrate the hemisphere in geographical and astronomical text-books.

In 1660 J. B. Nicolosi simplified the Fournier construction by substituting circular arcs for the meridional ellipses. This form of framework, re-introduced about 1793 by Aaron Arrowsmith as the Globular Projection, became popular as a means of representing the globe in two hemispheres.

3. *A Modern Projection*

A projection where mathematical resources were brought into action was treated in full by Lagrange in 1781, having been previously described by J. H. Lambert in 1772. This projection, which is autogonal or orthomorphic and involves two orthogonal systems of circles,

was not constructed on the polyconic idea. The projection will merit much further consideration.

4. *The True Polyconic*

The true Polyconic may be defined as a development of the sphere on a continuously changing cone, so that the parallel is always a circle whose radius is actually or approximately equal to the generator of the cone tangent to the terrestrial spheroid at the parallel of the latitude in question.

The first of the true polyconics was designed in 1853 by E. B. Hunt of the Coast and Geodetic Survey of the United States. In this system, very widely used for topographical maps, lengths along the central meridian and the parallels are made true, so that the other meridians are rather complicated curves, though they approximate very closely to straight lines on medium and large-scale maps.

5. *The Rectangular Polyconic*

It is to Col. A. R. Clarke, R.E., of the Ordnance Survey, that we owe the Rectangular Polyconic. This system, devised in 1858, has a close resemblance to the Ordinary Polyconic, as Hunt's projection is generally known; but it differs from the latter chiefly in being orthotomic. Both forms of polyconic map have the great advantage of being readily constructed from tables, but whereas the Ordinary Polyconic is generally applied to the construction of topographical maps on medium and large scales, each sheet being framed on its own meridian so that the sheets are discontinuous east and west, the War Office has preferred the Rectangular Polyconic for single sheet chorographic or continental maps on scales of from 1/2M to 1/6M.

6. *Modifications of Rectangular Polyconic Projection*

The rectangular polyconic can be modified in various ways, since it contains one disposable parameter. In its common form, distances are made true on the equator; but it may be altered so as to make distances true on any selected parallel.

Another modification consists in bringing the scales on a chosen central parallel up to the scales on the meridians at the parallel. The effect is that orthomorphism is established on the parallel and remains reasonably well established up to say 20° north and south of the parallel. Locally the modified projection then approximates closely to that of Lagrange and has an advantage over the latter in that it can

be constructed from general tables. The projection may be further improved by a constant reducing factor, so chosen that the scale on the central parallel at a point about seven-tenths of the distance from the central meridian to the east or west margin of the map is made true.

7. *The Rectangular Polyconic as a World Map*

The common form of Rectangular Polyconic is illustrated in Germain's treatise (Pl. XIII, No. XXXVII). As a world map, it has the advantages that the scales on the central meridian and equator are true and that the polar areas are fairly well represented—advantages which it shares with the Ordinary Polyconic. In addition, it gives an orthotomic representation of the graticule. It has the disadvantage that the scale on the meridian at 180° of longitude is excessive near the Equator, being about six times the central scale. This may be compared with the Mercator, in which the scale is five at latitude 78° 30′; it must be remembered, however, that this six is the maximum scale of the Polyconic, whereas the maximum of the Mercator is infinite.

8. *The Lagrange Projection*

The Lagrange Projection may also be applied to a world map, the scale being finite at the limits, except theoretically at the poles themselves, where, moreover, the projection ceases to be orthomorphic.

The Lagrange projection, discussed very ably by Tissot, has merits which appear to have been overlooked by some writers. It would make an excellent partial world map, if the map were confined within certain limiting parallels; so that as such it would be at least as good as the Mercator, except for the special purposes of navigation founded on Mercatorial sailing. To be sure, the remark may be made that, since it contains both the Stereographic and Mercator as special cases, a general theory of navigation could be developed for the Lagrange which would reduce to a special theory for the Stereographic and to the ordinary Mercatorial system of sailing. The Lagrange is, in fact, one of the most general forms of orthomorphic or autogonal projection.

For a general world map, however, Lagrange does not improve on Mercator, and indeed lacks the latter's simplicity and ready adaptability to navigation. Like the Mercator, the Lagrange has an excessive scale error in high latitudes.

9. *A Composite Polyconic*

It will be remembered that the Ordinary and Rectangular Polyconics give a fairly good representation in high latitudes; they fail at 180° of longitude near the Equator. It is clear, therefore, that where the Polyconic fails, the Lagrange projection is fairly successful, and that where the Lagrange fails the Polyconic provides a fair representation. The two projections being thus, in this sense, complementary, one is immediately led to the view that a composite projection, in some sense the mean of the two, would provide a good world projection for general purposes. As one of the components, the rectangular form of Polyconic is naturally preferred, since its graticule, like that of the Lagrange, is orthotomic.

The result of combining the two projections is that the combined graticule is nearly orthotomic, the greatest departure from orthogonality being about latitude 25° and longitude 180°, where the angle of intersection falls to 77°. The Rectangular Polyconic gives true scales along both the central meridian and the Equator; hence along both these lines the scale of the Lagrange is improved; the scale error of the latter, moreover, in the higher latitudes is reduced by about one-half. On the other hand, the excessive scale of the Polyconic on the meridian of 180° near the Equator is reduced.

Over the whole map, the scale errors appear to be reduced to a point as near to the possible minimum as is consistent with a nearly orthotomic intersection of the graticule—the latter being a condition which, in the writer's opinion, should be preserved as far as practicable. The greater scale errors may be situated in the Pacific Ocean, so that the distortion of the continents may be kept as low as possible.

The view may be taken that it would be better to reduce the length of the Equator to say three-quarters of its true value. This would diminish the greater scale errors but it would not greatly improve the shapes.

10. *Concluding Remarks*

In considering any world map, there are two points which must be borne in mind.

In no continuous world map is it within the realm of the practicable to attempt to reproduce distances correctly. It is therefore absurd to assign any linear scale to such a map.

Projections which are orthomorphic preserve shape. This is a most valuable characteristic in maps of comparatively large scales; in world

maps it is a factor of extraordinarily little moment. For the preservation of shape is local only and great masses may actually be pulled more out of shape than if the projection were not orthomorphic. The appearance of Greenland on the Mercator Projection is, of course, the standing example of this form of distortion.

For a map of the whole sphere where it is not desired to maintain areas true, this "polyconoidal" projection—as it may perhaps be termed—appears to offer nearly as good a projection as can be reached without introducing discontinuity, except, of course, at the poles. The polar regions themselves are included; though distortion here is unavoidable, it does not appear so great as to vitiate appearances hopelessly.

The map is intended for showing communications and physical features.

MR A. R. HINKS said that he had been accustomed to think and to teach that the polyconic was admirable for single sheets, but of no use for a general map of large areas. He was grateful to Mr McCaw for showing that this opinion was not maintainable. The results were very interesting, but he (Mr Hinks) was unconvinced by this representation, because the outlying portions of the map were not shown. One could not grasp, from a square cut out of the centre, what were the merits of this representation of the Pacific, especially for showing communications. He would express the hope that many ardent students would realize the pleasure of exploration in this fascinating domain.

THE FIGURE OF THE EARTH

PROF. W. WERENSKIOLD

See *Geofysiske Publikasjoner*, v, No. 7 (Oslo, 1928).

Abstract

Both geodetic measurements and theoretical considerations lead to the result that the figure of the earth is represented by an ellipsoid of revolution, to a close approximation; in fact, if terms of the second order are omitted, the correspondence is perfect. But discrepancies occur which are not easily explained. The various geodetic measurements give different values for the dimensions of the meridian ellipse. By including terms of the second order in the calculation one ought to get a better coincidence. But it will then prove impossible to find one single ellipsoid of revolution that fits in best with the geodetic measurements; on the contrary, the dimensions of the "best" ellipsoid are dependent on the latitude. The ellipsoid which has the same axes as the earth's spheroid may be called the *principal ellipsoid*.

For each latitude it is possible to determine an osculating ellipsoid, having the same radii of curvature as the spheroid—in fact, the

"ellipsoid of reference." This osculating ellipsoid will be somewhat different from the principal ellipsoid in respect to the major axis and the flattening. The paper then deals mathematically with the question of finding the corrections which must be added to the constants of the principal ellipsoid in order to get the osculating ellipsoid.

Clarke and Bowditch, Helmert, Jordan, Buchholz and others have deduced equations which make the earth's meridian other than an ellipse and lead to quite considerable corrections for the radii of curvature, etc.

21 July

L'ATLAS PHOTOGRAPHIQUE DU RHÔNE

PROF. ANDRÉ CHOLLEY

I

L'Atlas photographique du Rhône que j'ai l'honneur de présenter, est, comme son nom l'indique, composé uniquement de planches photographiques (une planche par page) constituées par des vues prises en avion. Ces vues sont de deux sortes: des vues verticales et des vues obliques. Les *vues verticales* ont été toutes faites avec le même appareil (objectif F. 26) et à une altitude constante (2600 m.) de manière à donner une représentation à l'échelle du 1/10,000. Chaque cliché (18 × 24) couvre ainsi une bande de terrain dont la largeur moyenne est d'environ 1 km. à 1 km. 500 de chaque côté du Rhône et il chevauche du tiers le cliché voisin pour permettre un assemblage parfait des vues en planches. L'assemblage des vues en planches a été effectué par le Service Géographique de l'Armée avec tout le soin qu'exigeait cette opération; il est impossible dans une planche imprimée de reconnaître les raccords entre les différents clichés qui la constituent. Chaque planche représente une section de la vallée de 3 à 4 km. de long sur 2 km. 500 de largeur en moyenne. Les planches mises bout à bout déroulent ainsi le cours du Rhône et donnent le plan de sa vallée sans aucune interruption.

On a de plus recouvert chaque planche d'une feuille de papier transparent sur laquelle ont été portés les repères utiles: nom des principaux accidents du terrain, des rivières, des villages et hameaux, cotes d'altitude, d'étiage, etc. Une courte notice, enfin, donne les indications nécessaires d'ordre physique et économique.

L'Atlas comprend en outre des planches de *vues obliques* à raison de deux vues par planche. Celles-ci constituent essentiellement une documentation de caractère géographique. On s'est attaché à repro-

duire les vues d'ensemble, les formes topographiques les plus typiques, les types principaux de culture, les types de groupements industriels, les types d'habitat rural et urbain, bref tout ce qui a un intérêt pour la connaissance géographique de la vallée rhodanienne. Ces planches sont accompagnées d'un bref commentaire, et un renvoi indique la place de la vue oblique dans le plan photographique (vues verticales) ainsi que l'angle approximatif sous lequel la vue a été prise.

L'Atlas du Rhône comprendra trois fascicules correspondant chacun à une section du fleuve:

(1) fascicule: de la frontière Suisse à Lyon inclus,
(2) fascicule: de Lyon à Montélimar,
(3) fascicule: de Montélimar à la mer.

Chaque fascicule est constitué de 80 planches dont 50 de vues verticales et 30 de vues obliques.

Le format adopté est celui du spécimen. Chaque feuille retenue par un cordonnet peut se détacher, afin de rendre plus aisé le groupement des planches, leur comparaison et leur étude.

Tel se présente l'Atlas du Rhône par A. Cholley et F. Seive.

II

L'Atlas du Rhône n'est pas une représentation rigoureusement exacte, une sorte de plan directeur de la vallée du Rhône. Il aurait fallu, pour réaliser ce but, établir d'abord des repères précis sur le terrain et d'autre part, se livrer pour chaque cliché à un travail minutieux de restitution; l'opération reste toujours possible, les clichés étant particulièrement soignés. L'établissement d'un plan rigoureusement exact ne répondait du reste pas au but poursuivi.

Rien ne fera mieux comprendre ce but, par suite les caractères de cet atlas, que l'exposé des circonstances qui ont présidé à sa conception. Je l'ai conçu au moment où le vote de la loi sur l'aménagement du Rhône, si longtemps réclamé par les populations riveraines, avait déterminé dans la région rhodanienne un mouvement d'idées assez intense dont la principale manifestation fut la création à Lyon d'un Institut d'Études rhodaniennes que j'ai eu l'honneur d'organiser et de diriger de 1923 à 1928.

Avant d'entreprendre sur le fleuve des recherches précises n'était-il pas d'un intérêt primordial d'en fixer la physionomie par une représentation suffisamment exacte (digues, épis, bancs de graviers, etc.); elle se justifiait également pour la réalisation des projets de dérivation (force hydro-électrique), de ports (port de Lyon). Enfin, dans le domaine agricole et industriel, la vallée du Rhône était en pleine

transformation (développement des cultures fruitières et maraichères, construction d'usines de produits chimiques, de soie artificielle, de tissages et filature de soie naturelle, de constructions mécaniques qui amenaient un accroissement des centres urbains, et même la création de centres nouveaux). N'y avait-il pas là un moment intéressant à fixer avant que ces transformations n'aient donné au fleuve et à sa vallée une tout autre physionomie?

Sans doute, mais à condition que toute cette documentation rhodanienne fut établie le plus rapidement possible.

Lorsque j'eus l'idée de l'atlas, l'emploi de la photographie aérienne me parut seule devoir fournir la solution cherchée. Elle permettait la rapidité d'exécution et elle pouvait apporter la précision suffisante. Avec l'aide du Capitaine aviateur Seive, le spécialiste français le plus sûr en matière de photographie aérienne, le programme fut rapidement établi. Il est évident, en effet, qu'étant donné les difficultés, les délicatesses de l'exécution, l'œuvre n'aurait pu être menée à bien sans la collaboration intime d'un géographe et d'un technicien. Il fut décidé que l'on aurait recours aux vues verticales pour l'établissement d'un plan photographique continu à l'échelle du 1/10,000, la documentation géographique proprement dite pouvant se contenter de vues obliques comme dans les albums ordinaires. Ce qui fait l'originalité de l'atlas c'est d'abord cet emploi rationnel de la photographie verticale dans la représentation, non plus seulement d'une petite portion de territoire mais d'une longue zone comme la vallée du Rhône de la frontière suisse à la mer. C'est ensuite la combinaison de la représentation du terrain par des vues verticales avec celle des vues obliques, celles-ci venant tout naturellement s'ordonner, prendre place dans l'ensemble du plan photographique donné par l'assemblage des vues verticales. La combinaison des deux procédés seule peut donner la précision en même temps que le pittoresque.

Il est inutile d'insister sur les difficultés de la réalisation. Elles sont connues. Quelques exemples suffiront à le faire comprendre et en même temps souligneront la confiance que l'on peut avoir dans la précision du travail. La prise des vues verticales a exigé une connaissance complète de la vie du fleuve et des conditions atmosphériques de la région, époque des maigres et des crues, luminosité, etc. La période est courte pendant laquelle on est mis d'obtenir des résultats satisfaisants: huit ou dix jours du printemps et au début de l'automne. Il a fallu tenir compte d'autres conditions encore, en particulier de celles qui règlent l'ombre et l'éclairement. Les ombres ne sont pas toutes les mêmes; certaines sont opaques, d'autres, au contraire, assez

"lumineuses"; ces caractères paraissent dépendre non seulement de la saison, mais encore de l'heure même de la journée.

Je pense toutefois que le résultat est atteint. On a un plan photographique suffisament exact—l'échelle de chaque planche a été précisée—rapidement exécuté, représentant tout le cours d'un fleuve et sa vallée. On a obtenu d'autre part une documentation géographique ordonnée, sur une région où les contrastes de relief, du climat, d'exploitation sont nombreux et marqués. On est même arrivé à dégager des indications intéressantes sur la façon de prendre en vue verticale les formes du relief, par exemple les escarpements calcaires. Ils sont très nettement saisis par l'effet d'une sorte d'éclairement par réverbération qui accuse convenablement leur relief. L'étude des ombres a permis aussi de faire venir en vues verticales des formes tout à fait secondaires mais d'un grand intérêt géographique.

DE L'UTILITÉ DE RÉPANDRE LA CONNAISSANCE DES FAITS GÉOGRAPHIQUES PAR LEUR REPRÉSENTATION GRAPHIQUE

JACQUES LÉOTARD

Résumé

1°. De l'Atlas statistique de la XI^me^ région économique de la France (Provence et Bas-Rhône), établi par M. Henri Brenier, sous le patronage de la Chambre de Commerce de Marseille.

2°. De l'Aperçu graphique des Colonies françaises, dressé par M. Jacques Léotard pour la Semaine Coloniale.

Il n'est pas besoin de démontrer les avantages que présentent les graphiques et figures pour faire mieux comprendre, en attirant plus vivement l'attention, les faits géographiques d'ordre statistique ou autres. Ce procédé de simplification fait sauter aux yeux les comparaisons les plus diverses et possède une puissance d'enseignement très supérieure à des tableaux de chiffres, qui nécessitent un véritable examen. Aussi ne saurait-on trop encourager un emploi croissant des méthodes graphiques.

I. Le grand Atlas statistique de la XI^{me} région économique de la France, dû à l'ingénieux labeur et à la compétence économique de M. Henri Brenier, Directeur-général des Services de la Chambre de Commerce de Marseille, membre du Conseil de la Société de Géographie, se compose d'une centaine de planches en couleurs du format in-folio, représentant toutes les formes de la grande activité économique du Port de Marseille et du Sud-Est de la France. Il comprend

à la fois des cartes et des graphiques, avec des légendes détaillées. Toutes les catégories de productions et de commerces sont clairement figurées, ainsi que l'outillage et le mouvement économiques. Les Départements se trouvent comparés entre eux et les années étudiées sont en général 1913 et 1925. C'est une œuvre très remarquable et qui mérite de servir d'exemple.

II. Le petit "Aperçu graphique des Colonies françaises," imaginé par l'auteur de la présente communication, est un trait de propagande utilisé à l'occasion de la Semaine Coloniale annuelle. Il se compose de onze graphiques ou figures, tirés soit en une seule grande feuille, soit en petits cahiers. On y trouve les totaux et la comparaison entre Colonies des superficies, des populations, du commerce français en général, des budgets, des ports et grandes villes, des chemins de fer, des fleuves, des forêts, du bétail, ainsi qu'une carte où la surface du domaine colonial français est projetée sur celle de l'Europe, qu'elle surpasse.

LE GÉNÉRAL BOURGEOIS fait remarquer l'utilité qu'il y aurait à faire au cours de certaines périodes de 10–15 ans, par exemple, de nouvelles éditions des feuilles de l'Atlas, dont l'évolution aurait été important. Cela permettrait des comparaisons tout à fait utiles.

GEODETIC SURVEYS IN NORTH AMERICA

COL. E. LESTER JONES

The geodetic work of the United States which is of interest to geographers consists of triangulation, levelling and geodetic astronomy. With the data secured in the operations of these branches of geodesy, the basis for accurate charting and mapping can be laid.

The triangulation system of the United States consists mostly of first-order arcs. These will be supplemented soon by a number of second-order arcs. In the interior of the country the triangulation consists, at present, of 25,000 miles of arcs of first-order triangulation and traverse. Along the coasts, it consists of a narrow strip of second-order or third-order triangulation which is used for the immediate control of the hydrographic and topographic surveys along the coast. From the eastern boundary of Maine to New York Harbour, an arc of first-order triangulation also extends along the coast and the third-order or detailed triangulation is tied into it at many points. There is no first- or second-order triangulation on the Atlantic coast south of New York, nor is there any along the Gulf coast.

On the Pacific coast, detailed triangulation of second- or third-order accuracy extends from the Canadian boundary southward to

the Mexican boundary. From the vicinity of San Diego to Ross Mountain, in latitude 40°, there is an arc of first-order triangulation to which the detailed triangulation is connected at intervals. From the 40th parallel of latitude to the Columbia River, the coastal triangulation, which is third-order in accuracy, is being connected at intervals with an interior parallel arc of first-order triangulation. From the Columbia River to the Straits of San Juan de Fuca and along those straits, the coastal triangulation may be considered as second-order in accuracy.

In the future development of the triangulation system of the United States it is planned to have second-order triangulation executed along the Atlantic coast south of New York Harbour, along the Gulf coast, and along those parts of the Pacific coast, where the control is not at present of sufficient strength.

Nearly all of the first- and second-order triangulation of the United States has been executed by the U.S. Coast and Geodetic Survey. A part of the first-order net, however, has been executed by the U.S. Lake Survey which has arcs extending along the Great Lakes, between the United States and Canada.

In 1901 the triangulation net of the United States had been extended sufficiently to justify tying it together into a single system with a single initial station, to which the geographic positions could be referred. This was done by adopting as the initial station Meades Ranch, Kansas, whose latitude and longitude were fixed at 39° 13′ 26″.686 and 98° 32′ 30″.506, respectively. The Clarke spheroid of 1866, as expressed in metres, was also adopted at the same time as a basis for computing the geographic positions. The adopted geographic position for the initial station, together with the Clarke spheroid of 1866 as expressed in metres, was designated the United States Standard Datum. In 1912 this datum was also adopted by the geodetic organizations of Canada and of Mexico and the designation was changed to that of North American Datum, owing to its international character.

While notable progress has been made in the extension of the triangulation system of the country, much still remains to be done. It is planned to have sufficient first-order arcs that the intervals between them will not be greater than about 100 miles. Between each two first-order arcs it is planned to have a second-order arc so that no place in the country will be more than about 25 miles from a station of first- or second-order accuracy. The remaining areas will then be covered by third-order triangulation by the engineers who are making the detailed topographic surveys and maps.

With the adding of new arcs to the triangulation system of the country, it was found to be increasingly difficult to adjust the new work to the old without greatly distorting the former. This condition is always encountered where a large area, like that of a country or a continent, develops its triangulation system gradually. Engineers and geographers are always anxious to secure the results of an arc of triangulation as soon as possible and this makes necessary the preliminary adjustment of an arc and fitting it into the existing network. This is just what happened to the triangulation of the United States.

A few years ago a method was devised in the office of the U.S. Coast and Geodetic Survey by which a great network of triangulation can be adjusted at a reasonable cost in time and money. It was felt that the net of the western half of the country had been sufficiently developed to justify a readjustment. This readjustment has now been made; and from the 98th meridian to the Pacific coast we now have a strong framework, composed of adjusted arcs of first-order triangulation into which new arcs can be fitted in the future without the new work having to be badly distorted. The maximum difference in the geographic positions of a triangulation station in the western part of the country resulting from the new adjustment is about 43 m. This distance would not be perceptible on the average small-scale map or chart, yet it is too great to be tolerated as a distortion in the fundamental triangulation system of the country.

It is expected that, in two or three years, the network of triangulation in the eastern half of the country will be developed to the point where a readjustment of that portion of the net can be made also.

There are many uses for the triangulation results, but the one of most immediate importance in the United States is the control of the topographic mapping. The charting of the coasts is also dependent upon this triangulation system. Other uses for triangulation are in the control of surveys and maps of international, state and county boundaries, the control of the surveys of cities and rivers, the alignment of railroads and highways, and other engineering projects where a knowledge of geographic positions or the distances between points is essential.

The U.S. Coast and Geodetic Survey has been confronted with a number of difficult, though very interesting, problems in connection with the extension of its triangulation system over the country. The development of a method for adjusting a large net of triangulation has just been mentioned as one of our recently solved problems.

Another problem is the control of azimuths in an arc of triangulation.

It has been our experience, and we believe that of geodetic engineers in all countries, that an arc of triangulation tends to swerve from its true direction. This swerving is far greater than might be expected from the accumulated effects of accidental errors. This problem was solved some years ago by the Coast and Geodetic Survey by the use of Laplace azimuths. A Laplace azimuth, as is well known, is simply an azimuth observed on Polaris, corrected for the deflection of the vertical at the point of observation. By the use of Laplace azimuths, arcs of triangulation can be held very closely to their true directions. About 70 Laplace azimuths were incorporated in the triangulation system of the western half of the country and their use greatly strengthened the results of the readjustment just mentioned.

For many years the Coast and Geodetic Survey tried to invent or devise a bar with which first-order base lines could be measured with great accuracy. The last bar that was devised was used for the measurement of the Great Salt Lake base line in 1896. It gave very accurate results and was comparatively easy to handle. A few years after this the Coast and Geodetic Survey made a comparative test of long steel tape lines and the base bar used on the Great Salt Lake base. It was found that, when measurements were made at night, the steel tapes gave results of sufficient accuracy for first-order bases. Later, steel and invar tapes were used together in field measurements of bases and it was discovered that invar tapes gave excellent results, even when the measurements were made during the day. Since 1906 all first-order bases in the United States have been measured with invar tapes.

Experiments have been made continuously by the Coast and Geodetic Survey to develop apparatus which will expedite triangulation observations. For instance, lamps of various kinds have been tried in order to make night observations possible. No lamp could be found that was entirely satisfactory until the development of the automobile electric headlight. By using a headlight with a special contracted filament bulb we are now obtaining excellent results and greatly reducing the cost of the triangulation in both time and money.

Many years ago the engineers of the Coast and Geodetic Survey followed the general practice of that time in the erection of signals to elevate the instrument, heliotrope and targets at triangulation stations, in order to make the lines of sight between stations clear. About 30 years ago, J. S. Bilby, a member of the Coast and Geodetic Survey, devised what was called the slender type of tower. In it only about two-thirds as much lumber was used as with the older type. The cost of even the slender type of tower became excessive, however, as the

cost of lumber mounted higher and higher. Mr Bilby then devised a steel tower which can be erected and taken down many times before any of the parts deteriorate or become worn to such an extent as to make them unusable. After the anchors have been put in place, a party of four men can easily erect a 75-ft. Bilby steel tower in 3 hours. Such a tower can be taken down by a similar party in less than 2 hours. The shortest time in which a 75-ft. wooden tower was ever erected was 12 hours and a much larger party was required.

The Bilby steel towers were used, in the state of Minnesota during the season of 1927, along arcs totalling 476 miles in length. Some of these towers were again used on the triangulation extending along the western coast of Florida during the early part of the present year. During the present summer two triangulation parties, operating in the interior of the country where the land is comparatively level and partly wooded, will use the Bilby steel towers.

Another important part of the geodetic work of the U.S. Coast and Geodetic Survey is the extension of a network of first-order levelling over the country. The levelling done by this Bureau has been supplemented in the past by some work done by the Corps of Engineers of the U.S. Army, the Mississippi River Commission, the U.S. Lake Survey, the U.S. Geological Survey, and several railroads of the country. Of the 53,000 miles of levelling in the country, 37,000 miles have been executed by the Coast and Geodetic Survey and the remainder by the other organizations.

The plans for the level net of the country call for lines of first-order levelling at intervals of about 100 miles with intermediate levelling of the second order between the first-order lines. When this net has been completed, practically every place in the country will be within 25 miles of a first- or second-order bench mark.

In the extension of the level net it has been assumed that the mean sea-level planes at different places along the coast, where tidal observations have been made, define an equipotential surface. This assumption is sufficiently accurate for the standard elevations in the interior of the country which are used for geographical and engineering purposes. A readjustment of the level net during the past year has shown that there is a gradual slope upward from south to north along the Atlantic coast and also along the Pacific coast of the United States. It has also been found that the sea-level surface on the Pacific side of the country is approximately 2 ft. higher than on the Atlantic side. On the Atlantic coast the sea-level surface slopes upward 0·26 m. from Fernandina, Florida, to Portland, Maine, and on the Pacific coast it

slopes upward 0·26 m. from San Diego, California, to Seattle, Washington.

The accuracy of the first-order levelling in the United States conforms to the specifications for levelling of high precision, adopted at the Hamburg meeting of the International Geodetic Association, in 1912. The correction per kilometre to close a levelling circuit in the United States averages about 0·12 mm. per km. This accuracy is sufficient to meet all geographic, engineering, and other needs.

The astronomic work done by the Coast and Geodetic Survey consists in the determination of latitudes, longitudes and azimuths at triangulation stations. The Laplace azimuths mentioned earlier in this paper are derived from the astronomic azimuths and longitudes. The astronomic data are also used from time to time in the determination of the shape and size of the earth and in efforts to disclose variations of density in the outer portion of the earth. These are normal items of research in the activities of any geodetic organization.

The officials of the U.S. Coast and Geodetic Survey have, from the beginning of the organization's existence, kept in close touch with geodesists of other countries. Our engineers have profited by the experience of those in other countries and we hope that the solutions we have obtained for some of our problems may be of value to geodetic workers in other countries.

LE GÉNÉRAL PERRIER, représentant la Section de Géodésie de l'Union géodésique et géophysique internationale, se fait l'interprète de cette Section en exprimant l'admiration de géodésiens du monde entier pour la belle œuvre accomplie par le "U.S. Coast and Geodetic Survey." Ce Service, en ne perdant pas de vue la nécessité de diriger ses travaux en vue des utiles applications pratiques de la Cartographie, n'a jamais perdu de vue le haut intérêt scientifique que l'on peut donner aux opérations géodésiques. Il suffit de citer, pour en être convaincu, les nombreuses déterminations astronomiques exécutées par lui sur l'immense territoire des États Unis. Les déterminations de gravité que le Col. Lester Jones a passées sous silence ont contribué aussi aux belles études sur l'isostasie connues de tous.

Un fait tout à fait remarquable à noter est l'unité géodésique du continent nord-américain, réalisée, grâce à l'U.S. Coast and Geodetic Survey, par le calcul de toutes les triangulations du Canada, des États Unis et du Mexique sur un même ellipsoïde, en partant du même point origine!

En plaçant à sa tête, comme président, le Dr Bowie, chef de la Division de Géodésie du Coast and Geodetic Survey, la Section de Géodésie de l'Union géodésique et géophysique internationale a reconnu la valeur tout à fait exceptionnelle de l'œuvre accomplie par le Col. Lester Jones et ses collaborateurs.

LT.-COL. C. M. BROWNE said he had listened with great interest to Col. Lester Jones' paper on the work of the Coast and Geodetic Survey, which was of particular interest to those who were professional geodesists. It seemed a pity that time did not permit Col. Lester Jones to go into more detail, but there were a few points about which he would like to ask for further

information. (1) In regard to the statement that the Geodetic Azimuths were controlled by Astronomic Azimuths, corrected for deflection of the plumb line: were separate observations taken to determine this, because in the Survey of India it was the practice to use this difference between Geodetic and Astronomical Azimuths in order to obtain a value for the deflection of the plumb line in the Prime Vertical? (2) As to the light used for night-work: the Survey of India had tried experiments and found that for long distances a yellower light penetrated dust, etc. better than white light, and that acetylene, petrol vapour with incandescent mantles, and even electric light were inferior to a yellowish kerosene oil flame, controlled by a clock-work fan, instead of a glass chimney.

COL. LESTER JONES, in answer to Col. Browne's remarks, said (1) that the U.S. Coast and Geodetic Survey took care of the accidental error by gravity determination, and (2) that they had found the contracted filament bulb quite satisfactory at somewhat shorter distances than those covered by British geodesists.

In a supplementary answer to a question by Col. Crosthwait he said that the Bilby steel tower weighed from 25 to 33 per cent. of the old wooden towers.

SHORT STUDY OF AMERICAN AERIAL PHOTOGRAPHIC METHODS

A. UZEL

Abstract

This paper presented a study of aerial photographic methods used in America, with a view to their possibilities as applied in geographical exploration. The processes used by the U.S. Geological Survey—the Brock and Weymouth—were described technically. While each of these methods had advantages for the particular purposes in view—sc. topographical and engineering works—their practical application in geographical exploration remained doubtful. The paper, nevertheless, emphasized the usefulness of aerial surveying methods in unknown regions. The desiderata are simplicity, accuracy, the reduction of ground control points to a minimum, and lessened cost. While the ideal instrument and processes are still to be sought, they will doubtless be found in time by the makers who are competing in this field.

COL. BIRDSEYE said that the U.S. Geological Survey considered that the Brock-Weymouth method of stereoscopic aerial surveying was admirably adapted to large-scale topographic mapping, on scales of 1/24,000 or larger, but under present conditions found it too expensive for small-scale mapping, such as that on the standard scale of 1/62,500, and doubted the advisability of its use on exploratory surveys as suggested in the paper. The Geological Survey had purchased the Hugershoff-Heide aerocartograph, and believed that the use of this or similar apparatus was better adapted to exploratory and other small-scale surveys.

23 JULY

GEOGRAPHIC BOUNDARIES

COL. E. LESTER JONES

The determination and fixation of some national boundary lines is a process that has taken many years to bring about, and may be said even to run with the history of the nations themselves. Such, I think, is true as regards the boundary line between the United States and Canada; and owing to the unusual length of this line, it has occurred to me that a brief statement of the salient facts in the history of the determination of this boundary might be of interest to this assembly of geographers.

In the first place, this line developed in parts, as the United States extended its territory. The several sections have been agreed to and fixed, from time to time, by a lengthy series of treaties and conventions, beginning with the provisional treaty of peace in the year 1782. This treaty described the line as far westward as the Lake of the Woods. Later treaties projected it westward, coincident with the growth of the country, to the waters of the Pacific Ocean.

At the east end, this line starts at the Atlantic Ocean in latitude 44° 46′ 36.″11 and longitude 66° 54′ 11.″32. Thence it goes through Passamaquoddy Bay and then to the mouth of the St Croix River, which it follows up to its source at the head of Monument Brook. At this point a cedar post was set in 1817 to identify the River St Croix as the boundary stream mentioned in the treaty of 1782. The cedar post was replaced by a large iron monument in 1843. From this monument the boundary runs north to a point on the St John River near Grand Falls, New Brunswick. Thence the line runs up the St John River to the St Francis River and then northward to Lake Pohenagamook. From this lake the line takes a straight course southwestward to the head of Halls Stream, crossing along the so-called "Highlands" which divide the St Lawrence River Valley from the headwaters of the streams that flow to the New England coast. The line then descends Halls Stream and follows along Vermont and New York States to the St Lawrence River. It ascends this river and passes on westward through the Great Lakes and connecting waters to the mouth of Pigeon River on the west shore of Lake Superior. At this point the line traverses a maze of inland watercourses, at the western end of which is what the treaty termed the "Northwest Angle of the Lake of the Woods."

From the so-called Northwest Angle, the line runs due south to the 49th parallel of north latitude, and thence westward along this parallel, across the plains and high mountain ranges, to the Gulf of Georgia, where it leaves the 49th parallel and follows the Straits of Georgia, Haro, and Juan de Fuca to its western terminus at the Pacific Ocean at latitude 48° 29′ 38″.11 and longitude 124° 43′ 34″.69 west.

The boundary line just outlined has a length of 3987 miles.

As before mentioned, this boundary line was developed in parts, due mainly to the fact that the growth of the two countries was chiefly from the Atlantic seaboard westward. So that the whole line divides itself into six sections, as follows:

(1)	Atlantic Ocean to source of St Croix River ...	155 miles.
(2)	Source of St Croix River to the St Lawrence River	670 ,,
(3)	St Lawrence River and Great Lakes	1289 ,,
(4)	Lake Superior to Lake of the Woods	426 ,,
(5)	Lake of the Woods to Gulf of Georgia	1297 ,,
(6)	Gulf of Georgia to the Pacific Ocean	150 ,,
		3987 ,,

The section at the eastern end of the line was first given attention, and the others were taken in order, going westward.

The Alaska-Canada boundary line must also be considered in regard to the great work of the fixation of boundary lines between the United States and Canada.

The Alaska-Canada boundary line has its origin in Dixon Entrance and extends first to the head of Portland Canal, whence it goes from mountain peak to mountain peak, roughly parallel to the windings of the coast, till it reaches the 141st meridian on the western slope of Mount St Elias, at an elevation of 13,500 ft. above sea-level. From this point it runs due north along the 141st meridian to the Arctic Ocean, a right-line distance of 647 miles from Mount St Elias to Demarcation Point on the shore of the Arctic Ocean—the longest straight-line stretch of boundary anywhere.

This line has ordinarily been considered in two parts, that from Cape Muzon to Mount St Elias, 893 miles long, and that from Mount St Elias to the Arctic Ocean, 647 miles in length.

The total length of the two boundaries is 5527 miles, or almost

double the distance across the Atlantic from the easternmost Canadian Province to the British Isles.

While much work was done from time to time during a hundred and more years in fixing parts of these boundaries, yet the great task of delineating and marking them throughout their entire length of 5526 miles, as they now stand, may be said to have been carried through since the beginning of the twentieth century, or in a little more than twenty-five years.

The fixing, marking, and mapping of these boundary lines have all been tied in with the first-order triangulation work of the United States and of Canada, and every boundary monument has been connected therewith, and their geodetic latitude and longitude are on record. So that should any monument hereafter become displaced or obliterated, it can readily be re-established by its known geographic co-ordinates.

In establishing the geodetic control for these boundaries, and for the topographic maps made in connection with the boundary surveys, it was necessary to determine 20,000 geographic positions. There are 10,310 straight-line courses in these boundaries, and there are 5460 monuments and 2521 reference monuments. There are 255 topographic maps covering the routes of these boundaries, these maps being among the finest produced anywhere, and they satisfy the treaty stipulation for "accurate modern charts."

The foregoing is but a hasty sketch of salient features of an important mutual undertaking by two nations co-operating for a single purpose. Its history shows some unique features. Among these, it may be pointed out that no cause for war has ever arisen about any part of these lines. No military garrison exists at any point along this vast stretch of boundary line, which stands as a visible mark of the peace and amity that can exist among nations.

It is right and proper to say that our neighbours and friends to our north, and the Home Government as well, have at all times been found co-operating in the fullest and friendliest way in the carrying out of this great boundary survey and its demarcation, and have contributed their full share of the cost and duties which the great task imposed upon each country. We of the United States most heartily congratulate them upon their generous co-operation and help in bringing this important work to such a happy conclusion and the attainment of its full purpose.

MAJOR G. G. AITKEN referred to the importance of International Boundary Survey, which, in regard to British Columbia, provided a major control for

the secondary or provincial system of legal surveys for lands, forests and mining claims.

The "pan-handle" of Alaska closes the northern half of British Columbia territory from access to the ocean. Nature, in the form of glacier recession at the head of Reid Inlet, has overcome the treaty boundary by providing an area which lies to the eastward of the boundary of Alaska and British Columbia. This area has a hinterland which, as far as hitherto surveyed, does not present a possible land-passage.

MR A. R. HINKS asked permission to take advantage of the presence in England of Col. Lester Jones to elucidate two historical questions which had always interested him: first, whether any steps had been taken to clear up the position of houses standing on the boundary, which in the present state of the law had certain peculiar advantages; and secondly, whether anything had been discovered of the fate of the U.S. Commissioners' report on the section of the 49th parallel west of the Rockies. When a difficulty arose owing to the duplication of lines, from the great discordance between astronomic and geodetic latitudes, neither side's report could be found. The Canadian report at last turned up on the shelves of the Royal Observatory at Greenwich, and has since been published. It would be interesting to know if the U.S. report has ever been found, for it would be of much importance in the history of the subject.

COL. LESTER JONES replying to Mr Hinks' first question said that there were houses still standing on the International Boundary, portions of which were on either side of the line. This condition, as pointed out by Mr Hinks, is creating peculiar interest at this time. As to the second point, he did not recall the presence of the paper mentioned, in the files of the American section of the commission.

LA CARTE DU SAHARA AU 500,000e, ÉDITÉE PAR LE SERVICE GÉOGRAPHIQUE DE L'ARMÉE

COLONEL PENEL (for GÉNÉRAL BELLOT)

Jusqu'en 1920, le Service Géographique de l'Armée n'avait encore publié du Sahara que des cartes par renseignements, au 800,000e et au 1,000,000e, très incomplètes d'ailleurs. Ces documents furent reconnus insuffisants dès que l'automobile et l'avion, en facilitant les transports, rendirent relativement aisée la pénétration saharienne et permirent de relier rapidement la Méditerranée au Niger. La nécessité apparut, dans ces conditions, de dresser une carte générale du Sahara, sur des bases topographiques, mais avec des méthodes adaptées à la nature particulière du terrain. On a renoncé à établir dans le désert une triangulation continue, même à larges mailles, mais les progrès réalisés récemment en radiotélégraphie permettant de recevoir aisément, avec un matériel léger, les signaux horaires des observatoires français, il est possible d'appuyer les levés sur un canevas de points déterminés par des observations astronomiques.

Les travaux topographiques exécutés à l'échelle du 200,000^e (la carte définitive devant être publiée au 500,000^e) ont amené les topographes à résoudre des problèmes entièrement nouveaux. C'est, qu'en effet, le Sahara constitue un ensemble géographique dont la morphologie présente des caractères très divers, spéciaux à chaque région naturelle.

La région des dunes comprend le Grand Erg Oriental et le Grand Erg Occidental dont le tracé épouse à peu près les limites du réseau quaternaire enfoui et qui, formés par l'érosion éolienne aux dépens d'alluvions accumulées au fond de cuvettes, occupent des zônes de moindre altitude. L'Erg Oriental s'étend, au Nord du 28° parallèle, sur presque tout le bassin de l'Oued Igharghar. Il semble se déplacer, vers l'Est et le Sud-Est, sous l'action des vents soufflant de l'Atlas et apparaît, ainsi, désaxé par rapport à ce bassin. L'Erg Occidental couvre la zône d'épandage des oueds quaternaires qui descendent de l'Atlas: Oued Namous, Rharbi, Seggeur, Zergoum, et leur barre aujourd'hui l'accès de la cuvette du Gourara. Cette cuvette, où l'eau est à fleur de sol, est marquée par une ligne de très belles oasis, envahies malheureusement par le sable dans la partie Nord. Une chaîne ininterrompue de palmeraies marque également la dépression de la Saoura formée par la réunion de l'Oued Guir et de la Zousfana et se prolonge jusqu'au Tidikelt. Entre l'Erg Oriental et l'Erg Occidental se développe un grand plateau calcaire d'origine crétacée: le Tadmaït, immense synclinal en relief dont l'axe orienté Nord-Est–Sud-Ouest est occupé par l'Oued Mya qui coule vers Ouargla et Touggourt.

Les ergs et le plateau intermédiaire présentent des lignes généralement fuyantes, mais parfois très heurtées et dont les divers aspects ont reçu des indigènes des appellations spéciales:

Hamada: socle du plateau, peu ondulé et monotone.

Chebka: ravins en cañons creusés dans le plateau.

Gour: buttes calcaires découpées par l'érosion en bordure du plateau et surmontant des bancs moins résistants (tuf, marne, argile).

Entre les éléments épars du plateau démantelé, se trouvent des zônes d'aspect différent.

Le reg: plaine marno-argileuse, "terrain de choix pour la marche, la chevauchée et le roulage."

Les sebkhas et les chotts: cuvettes à fond argileux où séjourne une nappe d'eau généralement saturée de sels de magnésie.

Chaque mission topographique envoyée annuellement au Sahara pour une campagne de quatre mois comprend deux brigades (de 2 ou 3 opérateurs officiers ou exceptionnellement sous-officiers), sous les ordres d'un chef de brigade. Ce dernier est chargé des déterminations astronomiques. La mission elle-même est commandée et administrée par un officier supérieur. Des indigènes de la région, recrutés par les autorités militaires locales, constituent l'escorte de protection de chaque officier et servent en même temps d'aides. Chaque opérateur dispose aussi d'un soldat français, de 6 goumiers montés à méhari (dont deux guides connaissant parfaitement le pays). Il utilise pour le transport de son matériel 8 chameaux de bât conduits par 3 chameliers. Quatre chameaux de bât supplémentaires sont mis à la disposition du chef de brigade. Les détachements se mettent en route avec des vivres pour deux mois, un ravitaillement pour les deux derniers mois de la campagne ayant été rassemblé par les soins de l'autorité locale en un point déterminé.

En chaque point astronomique sont déterminés la latitude, la longitude, un azimut issu de la station et l'altitude. Les observations astronomiques se font à l'astrolabe à prisme, petit modèle. Le garde-temps employé est un petit compteur, battant la demi-seconde, dont le transport se fait aussi aisément que s'il s'agissait d'une simple montre. Pour obtenir la longitude, on reçoit par T.S.F. les signaux horaires des stations LY (Bordeaux) à 20 heures et FL (Paris) à 22 heures 30. Ces signaux sont enregistrés par la méthode des coïncidences. Un type d'appareil récepteur, peu encombrant, a été réalisé spécialement pour les brigades du Sahara par les soins de l'Établissement central du matériel de la Radiotélégraphie militaire (l'appareil et ses accessoires pèsent 60 kg.). Un sapeur radiotélégraphiste est chargé d'en assurer le fonctionnement.

En principe, l'azimut d'un repère est déterminé par des visées sur la Polaire, faites avec un petit théodolite réitérateur. Le poids de cet instrument est de 21 kg., y compris le pied et la boîte. Dans la mesure du possible, l'officier chargé de ces mesures précède les opérateurs, de telle façon qu'ils puissent trouver, lors de leur passage au point, les coordonnées calculées. Le point de station est, en outre, rattaché autant que possible à un détail marquant du terrain, pouvant servir de repère (signal sur une falaise, pointe de rocher, puits, etc.). La densité des stations a été en moyenne de 15 par feuille, ce qui corrrespond à un écartement d'environ 60 km.

L'altitude s'obtient par comparaison des mesures de la pression atmosphérique faites avec un hypsomètre (du type Foucault) au point

même et des lectures effectuées au baromètre Fortin dans les postes installés dans l'Extrême-Sud par le Service Météorologique d'Algérie, postes dont l'altitude est exactement connue. Les lectures du baromètre se font à 7, 13 et 18 heures et sont transmises par T.S.F. sous forme de bulletins météorologiques, ce qui permet de faire les calculs sans tarder. Des postes météorologiques permanents existent actuellement à Ouargla, Beni Abbès, Timimoun, In Salah et El Goléa, c'est-à-dire à proximité des régions levées. On peut estimer à 20 m. l'approximation ainsi obtenue.

Le chef de la brigade assigne à chacun de ses opérateurs une zône à lever, et communique en même temps tous les renseignements qu'il a pu recueillir: nature du terrain, pistes, points d'eau, noms, etc. A l'aide de ces indications, le topographe, après avoir interrogé ses guides, détermine l'itinéraire approximatif qu'il suivra pour lever la zône fixée. L'opérateur exécute un cheminement d'un point astronomique à l'autre, en se servant de la jumelle stadimétrique (de grossissement 16) pour la mesure des distances, et de l'alidade holométrique pour l'évaluation des pentes. Au point origine, il mesure une base, en trace la direction sur sa planchette et note l'heure du départ. Il fait de même à son arrivée à la station suivante, ce qui lui permet d'avoir une valeur approchée de la distance parcourue et peut lui éviter de revenir en arrière, dans le cas où l'un des signaux de la base aurait disparu ou serait invisible. Après avoir décliné sa planchette, il mesure la distance entre les deux stations ainsi que la pente et met en place les accidents de terrain et détails de planimétrie qu'il a notés au cours de son déplacement sur un carnet aide-mémoire. Il procède à des visées sur les détails importants, il en détermine la distance, à vue jusqu'à 2 km., et par intersection au delà de cette distance. Enfin, il détermine une base nouvelle.

Il est fait, chaque fois que cela peut être intéressant, et pour le moins à chaque arrêt, des observations au baromètre de poche, pour noter les altitudes relatives des falaises, pitons, sommets de dunes, cuvettes, etc., toutes indications qui donneront à la carte une plus grande valeur, en même temps qu'elles faciliteront le tracé des courbes de niveau.

La toponymie est établie sur place à l'aide des guides; ces indigènes sont dressés à donner d'eux-mêmes tous les renseignements utiles (noms, profondeur des puits, existence de points d'eau, marabouts, tombes et autres détails); ils signalent également l'existence des pistes et des itinéraires fréquentés en région sablonneuse où les traces n'apparaissent pas nettement. L'opérateur entraîné parcourt de 15 à

25 km. par jour, levant une bande de terrain de 6 à 12 km. de large. Cette bande peut même atteindre 15 km. en région de dunes, car les vues sont alors en général très étendues, et les détails à représenter assez simples de forme. La distance entre les arrêts est en moyenne de 4 km. mais, si cet écartement peut être atteint et même largement dépassé dans l'erg, il n'en est pas toujours ainsi ni en terrain plat (reg ou hamada) où la réfraction, très intense à certaines heures de la journée, interdit toute visibilité au delà de 1800 m., ni en région de "Chebka," où les détails, très complexes, ont besoin d'être examinés avec plus d'attention. Les levés sont d'autant plus détaillés que les points d'eau sont plus rapprochés. L'opérateur dispose de moyens lui permettant de couvrir une distance de 150 à 200 km. sans ravitaillement en eau. Les mouvements sont réglés au départ par l'opérateur qui indique l'emplacement approximatif du camp prochain, d'accord avec les guides indigènes. Sous les ordres de l'aide français, le convoi se rend à destination par l'itinéraire le plus favorable, compte tenu du peu de mobilité du convoi. La levée du camp s'effectue au petit jour, afin qu'à l'arrivée à l'étape, les chameaux puissent paître pendant 2 ou 3 heures avant la tombée de la nuit. Lorsque le parcours doit s'effectuer en région plate ou peu accidentée, le convoi suit les traces de l'opérateur et ralentit son allure s'il arrive à le dépasser, afin de conserver la liaison avec lui. A l'arrivée au point astronomique, généralement situé auprès d'un puits, le topographe ferme son cheminement. L'écart de fermeture est acceptable quand il ne dépasse pas le 1/100° de la distance parcourue. L'écart peut être plus grand en certaines régions particulièrement plates et dénudées, où l'opérateur, pour gagner du temps, s'est contenté de marcher à la boussole et à la montre, déterminant les cotes au baromètre de poche.

En principe, le topographe change sa feuille de dessin au point astronomique. Il décline alors la nouvelle planchette en utilisant l'azimut, laissé par l'astronome. Sinon, il se décline à la polaire par des visées à l'alidade holométrique, en ayant soin d'opérer au maximum d'élongation. Ce dernier procédé a toujours donné des résultats satisfaisants, permettant à l'opérateur de vérifier fréquemment sa déclinaison.

La répartition des zônes entre les opérateurs peut être faite suivant plusieurs méthodes. L'une tend à donner à chacun des opérateurs une zône très étendue, en tous sens, couvrant jusqu'à 5 et 6000 km., le dessin est alors traité d'une façon homogène dans toute sa zône. Une autre consiste à attribuer aux opérateurs des bandes étroites de terrain (8 à 12 km. suivant les régions) joignant les points astrono-

miques. Les topographes peuvent ainsi se retrouver en ces points et recevoir de leur chef de nouvelles directives; d'autre part, ce dernier est en mesure de remédier aux divers incidents qui ont pu se produire en cours de route et d'assurer en permanence l'unité de représentation. L'expérience a montré que cette seconde méthode était généralement préférable à la première, car elle permet aux opérateurs d'utiliser toutes les positions astronomiques et surtout de discuter entre eux et sur place de la meilleure façon d'interpréter les formes du terrain. D'autre part, au point de vue moral, se sentir encadré en cas d'accident ou de maladie et retrouver tous les 8 ou 10 jours son chef et ses camarades est pour les officiers des brigades un précieux réconfort dans le désert.

Les officiers topographes sont mis à même, en parcourant le terrain en tous sens, de rassembler des informations susceptibles d'intéresser la géologie, l'archéologie, les transports aériens et terrestres. C'est ainsi qu'ils recueillent des échantillons de roches et de fossiles, des armes et des instruments préhistoriques, qu'ils constatent l'existence de monuments mégalithiques, qu'ils notent les points d'atterrissage, les zônes accessibles aux automobiles, etc., etc.

Les mappes sont dessinées sur place au 200,000^{e} par les officiers. Au Sahara, les détails de planimétrie sont rares et peu variés. Les points d'eau sont indiqués avec le plus grand soin; puits vivants, avec indication de leur profondeur et de la qualité de l'eau; puits morts, plus ou moins comblés. Un signe conventionnel a été adopté pour figurer les effervescences gypseuses (sebbak) qui se présentent fréquemment dans les dépressions et notamment dans les ergs. Seules, les pistes importantes, dont la trace est nettement marquée sur le sol, ont été conservées. Toutefois, dans les ergs, on reporte les chemins fréquentés par les caravanes, même quand il n'existe pas d'indication visible sur le sol. Les palmeraies, qui sont le plus souvent de faible étendue, sont indiquées par un signe conventionnel, sans indication de limites.

Un certain nombre de petits détails relevant de l'orographie, tels que buttes—témoins (gour) ou dunes isolées, susceptibles de servir de repère, ont été mis en place.

Avec l'équidistance de 50 m. adoptée, les courbes de niveau, même intercalaires, ne pouvaient suffire à figurer normalement de nombreux escarpements (gour) qui sont les seuls éléments orographiques. Pour y parvenir, on a eu recours au signe conventionnel des arrachements (hachures dirigées dans le sens de la pente).

Les mappes sont, en principe, reproduites par la photographie à

l'échelle même des levés, c'est-à-dire au 200,000ᵉ en édition provisoire, avec la toponymie complète. Dans la carte au 500,000ᵉ, on a généralisé le dessin des mappes en éliminant un certain nombre de détails et aussi quelques noms. Comme l'équidistance des courbes est de 100 m., on a pris soin de maintenir dans les parties dénudées et sans relief, tous les petits accidents de terrain utilisables comme repères. Le Service Géographique a publié jusqu'ici cinq coupures (de 2° sur 3°).

Une grande partie des levés ayant porté sur des régions de dunes, le Service Géographique s'est attaché particulièrement à l'étude de celles-ci. Ces grandes masses sableuses soumises à l'érosion éolienne et pluviale, et, de plus, intimement liées au relief subjacent, ne se présentent pas toujours de façon identique. Chaque erg a ses particularités et peut, lui-même, être divisé en plusieurs régions insensiblement rattachées entre elles, qui, soumises à des influences différentes, présentent elles-mêmes des aspects très divers. Cependant, il est possible de classer les formes du relief des sables.

C'est d'abord la plaine sablonneuse où le sable recouvre régulièrement la surface du sol et où, seule, la présence d'obstacles permet quelques accidents. Le sable, soumis à l'influence du vent dominant, s'entasse derrière l'obstacle pour former une dune. Le type le plus simple de dune isolée est la barkhane. A pente douce (de 5° à 15°) du côté d'où souffle le vent, elle a sa pente maxima sur l'autre versant. L'intersection des deux surfaces forme une arête vive, qui tourne sa convexité vers le vent. On dénomme la crête, et même la dune entière, sif (ce qui signifie: sabre ou tranchant), mot dont le pluriel est: siouf. Ce genre de dunes peut atteindre de 10 m. à 15 m. d'élévation. On ne le trouve guère que dans les régions dont l'ensablement est récent. C'est en quelque sorte le premier stade de la formation d'un erg. Si le sable continue à s'accumuler, les siouf finissent par se rejoindre et il se constitue un massif ininterrompu où d'autres types de dunes ne vont pas tarder à apparaître. La zemla est une dune présentant plusieurs sommets sensiblement égaux, qui lui donnent un profil aplati. De ses sommets partent de nombreuses crêtes, souvent longues d'un km., qui s'étalent dans toutes les directions. Le rhourde (pluriel orhourd) est une dune à sommet unique, d'où s'écartent trois ou quatre arêtes maîtresses et où le sable a une pente uniforme depuis l'arête du sif jusqu'au bas de la dune. Deux arêtes maîtresses voisines ont parfois tendance à se rapprocher l'une de l'autre vers le pied du rhourde enserrant ainsi une sorte de cavité presque circulaire dénommée par les indigènes: rhoraffia (ce qui signifie: anse). Les arêtes

rattachant les dunes entre elles, n'ont parfois qu'une hauteur de quelques mètres au point le plus bas. Entre les chaînes de dunes, se trouvent de longs couloirs appelés feidj, gassi, oueds, tséïrat, parfois dépourvus de sable, mais souvent barrés aussi par des siouf de petite taille; la circulation y est relativement aisée.

Pour la figuration de ces masses de sable, on avait, à l'origine des levés, convenu d'un signe tenant compte uniquement des hauteurs relatives. Par suite de la diversité des dunes et de l'intérêt qui s'attache à les traduire exactement, les topographes ont été amenés à rechercher une représentation plus fidèle et plus expressive. Pour avoir des indications certaines, des levés réguliers de dunes types ont été effectués à l'échelle du 20,000^e dans l'Erg Oriental. Généralisés au 200,000^e, ces levés ont été traduits par des dessins à l'effet au moyen de traits et pointillé dégradé, qui, judicieusement combinés, offrent une fidèle traduction des lignes saillantes du relief. L'examen de photographies prises en avion des rives de la Saoura a confirmé l'interprétation adoptée.

Au 500,000^e le topographe a cherché à laisser à chaque région son allure propre, en dépit des difficultés que crée à cet égard la réduction d'échelle. Il a respecté la direction générale des alignements de dunes, et leur nombre; les sommets les plus élevés sont tous indiqués et à leur place exacte. La généralisation a pu laisser aux gassi leurs limites précises. Les opérateurs des brigades sahariennes étant spécialisés dans ce genre de levés, en ce sens qu'ils font au Sahara plusieurs campagnes successives, il est possible d'obtenir, dans le dessin des régions de sable, une homogénéité convenable, d'une feuille à l'autre. Cette interprétation des régions de dunes, qui, à l'échelle des publications, ne paraît guère pouvoir être plus détaillée ni plus sincère, semble susceptible d'intéresser les géographes.

Communication faite par M. E. BARRALIER *au nom du Ministère français des Colonies.* Comme suite à la communication faite par M. le Col. Penel au nom du Service Géographique de l'Armée sur la carte du Sahara au 1/500,000^e, la délégation du Ministère français des Colonies pense qu'il peut être utile de faire connaître au Congrès l'œuvre cartographique réalisée dans ces dernières années en Afrique Occidentale Française par le Service Géographique de cette colonie sous la direction de M. le Commandant De Martonne.

Ce Service a été réorganisée en 1922 avec mission du Gouverneur Général d'établir des cartes de reconnaissances, des cartes topographiques régulières et des plans de détail, les cartes de reconnaissances devant, dans le plus bref délai possible, couvrir la totalité de la surface habitée par les populations sédentaires. Ces cartes ont été immédiatement entreprises. L'une à l'échelle du 1/500,000^e figure les régions qui s'étendent du Golfe de Guinée au 16° parallèle Nord, avec pour limite orientale le 3° Est de Greenwich. Une seconde carte, destinée à représenter les autres régions au 1/100,000, a été étendue par la suite à l'ensemble de l'A.O.F.

La carte au 1/500,000 a été terminée en 1926. Elle comprend 34 feuilles de 3° sur 2° de côtés et 4 demi-feuilles. A part quelques feuilles concernant des territoires sur lesquels des travaux de triangulation et des levés réguliers avaient été effectués, cette carte est presque entièrement établie à l'aide de documents antérieures d'origines diverses; mais ces documents ont été encadrés par des observations astronomiques d'une grande précision effectuées de 1923 à 1926, comme celles du Sahara à l'astrolabe à prisme, avec longitudes déterminées par T.S.F. (100 à 150 positions), et par un assez grand nombre de positions astronomiques antérieures d'une approximation suffisante en l'espèce. La carte ainsi obtenue n'est sans doute, pour la plupart des feuilles qui la composent, qu'une esquisse générale de l'A.O.F. Mais le Service Géographique de la Colonie poursuit ses travaux d'astronomie de position—on comptait 206 points en 1927—ainsi que les levés réguliers en vue d'une nouvelle édition.

La carte d'ensemble au 1/1,000,000, dont 4 feuilles publiées comme feuilles provisoires de la Carte Internationale du Monde viennent d'être revisées, a été éditée avec la collaboration et par les soins du Service Géographique de l'Armée dans la série des "Croquis du Sahara et régions limitrophes," qui venait d'être entreprise par ce Service. Dix-huit feuilles ont été dressées par le Service Géographique de l'A.O.F., dont les 4 dernières sont à l'impression.

Les cartes topographiques régulières comprennent des cartes au 1/200,000 et au 1/100,000 ainsi que les plans de Dakar. Au 1/200,000, 21 feuilles ont été publiées, dont 12 pour la partie côtière du Sénégal et 9 pour une partie de la Guinée française. Une partie seulement provient de levés récents mais les levés réguliers d'avant la guerre n'avaient pas encore été publiés à cette échelle. Trente-cinq autres feuilles, actuellement établies au titre de cartes semi-régulières, sont en préparation. Les feuilles au 1/100,000, au nombre de 12 pour le Sénégal et de 6 pour le Bas-Dahomey, proviennent de travaux effectués de 1905 à 1910 et déjà presque entièrement publiés. Elles ont été rééditées suivant de nouvelles coupures qui, conformément à la règle adoptée pour toutes les publications cartographiques de l'A.O.F., dérivent de la Carte Internationale du Monde. Dix-neuf feuilles sont en préparation dont 2, en Haute Volta, proviennent du récent levé de la frontière franco-anglaise. Pour ces deux feuilles on a utilisé un certain nombre de positions déterminées par M. le Capitaine Dale de l'armée britannique et obligeamment communiquées par M. Clendinning, Surveyor-General de la Gold-Coast.

En résumé, la carte au 1/1,000,000, considérée comme carte générale de reconnaissance, est presque achevée pour la totalité des 4,800,000 km. carrés de l'A.O.F., qui représentent environ 9 fois la superficie de la France. Il reste à la mettre au point pour qu'elle prenne sa place dans la Carte Internationale du Monde. Pour le 1/500,000 les 36 feuilles parues correspondent à la moitié, de beaucoup la plus intéressante, de la Colonie, l'autre moitié comprenant près de deux millions de km. carrés du Sahara. Les feuilles publiées de la carte au 1/200,000 correspondent au vingtième environ de la superficie totale de l'A.O.F., ou au dixième de la partie qu'il peut être utile de cartographier à cette échelle. En ce qui concerne le 1/100,000 il est bien difficile d'évaluer le pourcentage du travail effectué. L'établissement méthodique de cette carte pour la totalité de l'A.O.F. ne saurait être en ce moment envisagé. C'est là une œuvre de longue haleine qui suivra le développement économique du pays, mais dont il ne paraît pas possible de fixer dès maintenant le programme de publication.

EMPLOI DE LA PHOTOGRAPHIE AÉRIENNE POUR LE LEVÉ DES CARTES DE RECONNAISSANCE AU MAROC

COLONEL DE LAVALETTE

Le Service Géographique de l'Armée française, qui est chargé de l'établissement des cartes du Maroc, a constitué à Rabat un organe spécial, le Service Géographique du Maroc, pour dresser et éditer sur place les cartes de l'avant ou de reconnaissance, ainsi que tous les autres documents dont les États-Majors, les Troupes et les divers services du Protectorat ont un besoin immédiat.

Le Service Géographique de l'Armée s'est réservé l'établissement de la carte régulière aux échelles du 50,000^e, du 100,000^e et du 200,000^e. Il fait exécuter ce travail important et de longue haleine par des officiers détachés chaque année de France au Maroc pour une période de six mois environ.

Le Service Géographique du Maroc, tout en assurant la direction technique de ces travaux, s'occupe plus spécialement d'établir la *carte de reconnaissance* au 100,000^e et au 200,000^e. Il traite, de plus, toutes les questions géographiques, topographiques et cartographiques concernant le Protectorat, en collaboration avec le Service Topographique chérifien spécialisé principalement dans les questions cadastrales et foncières.

La carte de reconnaissance est dressée à l'échelle du 100,000^e à l'aide des documents de toute nature rassemblés ou exécutés par le Service, tels que levés expédiés, itinéraires, rapports de reconnaissance, etc., la source de renseignements la plus importante étant actuellement la photographie aérienne. Celle-ci permet l'étude de régions où les levés à terre sont difficiles ou impossibles à exécuter, et, dans les régions de parcours facile, elle fait gagner un temps considérable sur les procédés ordinaires. Grâce à elle, les trois quarts du Maroc sont dotés d'une carte provisoire de reconnaissance au 100,000^e, et celle-ci s'étend progressivement même aux régions où nous n'avons pas encore pénétré. C'est ainsi que, sur les 187,600 km. carrés levés à la date du 1er janvier 1928, 84,500, c'est-à-dire presque la moitié, ont été exécutés par phototopographie. Et cette proportion ira en augmentant, car actuellement plus des deux tiers des feuilles nouvelles sont établies par ce procédé. Il semble, dans ces conditions, que le Maroc soit, avec le Canada, le pays où ce mode de levé reste le

plus largement utilisé pour l'établissement d'une carte de reconnaissance à petite échelle.

Principe de la méthode de restitution

Au Maroc, la restitution des photographies aériennes s'effectue graphiquement sans le secours d'aucun appareil de restitution mécanique. Il existe cependant des appareils de ce genre permettant de constituer avec précision la planimétrie et les courbes figuratives du terrain, mais tous ils nécessitent l'exécution préalable d'une géodésie très dense, travail impossible à réaliser au Maroc, dans les régions où la carte est demandée.

Triangulation. Les points de repère indispensables pour établir la carte sont obtenus par un canevas géodésique exécuté dans la zone à lever ou en bordure de celle-ci si elle est inaccessible. Dans ce dernier cas, les points obtenus sont utilisés pour intersecter au théodolite tous les points remarquables de l'avant et en déterminer un plus grand nombre encore à l'aide de tours d'horizon photographiques pris à terre. C'est ainsi qu'en 1925–26, pendant les opérations du Rif, à chaque conquête du terrain, tous les repères naturels de la zone dissidente étaient recoupés des postes avancés: la détermination de leur position géographique a constitué un canevas géodésique qui a permis de faire progresser la carte, ou de l'améliorer, au fur et à mesure de notre avance.

Mais il est des régions qui ne se prêtent pas à ce travail, l'horizon visible à terre étant forcément limité. L'avion permet alors d'exécuter une véritable triangulation. La méthode utilisée à cet effet est exposée dans le Cahier no. 38, publié en août 1919 par le Service Géographique de l'Armée. Elle consiste, en principe, à déterminer la position de l'avion au moment où il a pris la photographie panoramique à étudier, position qui s'obtient au moyen d'un relèvement par restitution sur trois points connus, identifiés sur la photographie. Des constructions géométriques simples permettent ensuite de déterminer sur l'épreuve de nouveaux points de repère plus éloignés. En opérant ainsi de proche en proche, on détermine une série de points dont la précision en position et en cote décroit naturellement avec l'éloignement des bases, mais reste suffisante pour l'établissement d'une carte de reconnaissance.

Prise des films verticaux et des vues obliques. Les aviateurs ont réalisé, d'autre part, un programme établi par le Service Géographique et consistant en itinéraires partant des points de repère préalablement

déterminés, itinéraires au cours desquels sont pris des films verticaux ou succession de photographies verticales.

Ces itinéraires sont exécutés à haute altitude (4000 m. et même plus), pour couvrir la plus grande surface possible de terrain. Les clichés doivent être pris de façon à se recouvrir largement, par moitié environ, afin d'en permettre l'étude stéréoscopique.

Les itinéraires donnant les films verticaux ne peuvent être suffisamment nombreux pour couvrir tout le terrain. Leur exécution, dans ces conditions, exigerait de trop longs délais et une trop forte dépense. Ils sont donc généralement disposés en forme de vastes quadrilatères juxtaposés et dont l'intérieur est photographié obliquement. De telles épreuves obliques couvrent de vastes surfaces et donnent, de plus, une bonne idée d'ensemble du terrain.

Restitution proprement dite: établissement de la feuille. Les points de repère, déterminés par les procédés indiqués ci-dessus, sont utilisés pour réduire à l'échelle, par fragments successifs, le réseau hydrographique des films verticaux et le mettre en place sur une feuille de projection.

Celle-ci se couvre ainsi des éléments de thalwegs ou des thalwegs continus, survolés au cours des itinéraires exécutés par les avions et réduits à l'échelle. C'est l'ossature de la carte.

Établissement des mappes. Le travail ainsi préparé est alors réparti entre les divers opérateurs.

Chacun reporte sur sa mappe points de repère et réseau hydrographique, dont il recommence l'étude de détail et qu'il complète à l'aide des photographies obliques.

Puis, reprenant tous les clichés relatifs à son travail, chaque opérateur les assemble par couples et les étudie soigneusement au stéréoscope. Cet examen révèle les formes du terrain et permet d'en modeler le relief par des courbes de niveau, dont les altitudes sont déduites par approximation successive des cotes des points de repère.

Avantages et inconvénients de la méthode. Le principe de la méthode est donc simple, mais son application est délicate et exige des opérateurs une connaissance approfondie de la topographie. Le restituteur possède, il est vrai, l'avantage de voir le terrain dans son ensemble, puisqu'il travaille sur les épreuves prises de l'avion. Par contre, il ne peut, comme le topographe ordinaire, étudier ce terrain sous tous ses aspects ni parcourir les angles morts dérobés à sa vue sur les épreuves photographiques. D'autre part, c'est par approximations et comparaisons successives seulement qu'il peut déterminer les altitudes, en partant de points de repère souvent très espacés. Il doit donc être

doté d'un sens topographique très sûr et s'entraîner longuement à ce genre spécial de travail; c'est pourquoi les bons restituteurs ne s'improvisent pas.

Précision. Le travail exécuté dans ces conditions ne peut évidemment prétendre à une grande précision, mais il permet d'établir une carte de *reconnaissance* représentant le terrain avec sa physionomie et son apparence d'ensemble.

Des vérifications, exécutées sur des feuilles rédigées exclusivement par phototopographie, ont permis de constater que, dans les feuilles au 100,000^{e} mesurant 24 × 30 cm., et comportant de 4 à 8 points géodésiques bien répartis, les erreurs en position variaient en moyenne de 500 à 1000 m. Mais quand le canevas géodésique ou phototopographique était moins dense ou mal réparti, l'erreur a atteint plusieurs km., principalement dans les régions où les très fortes dénivellations du terrain rendaient la restitution très délicate. Dans ce dernier cas, les altitudes ne peuvent plus être déterminées avec une approximation suffisante : les courbes de niveau sont placées à l'estime, mais autant que possible en nombre, afin de donner la valeur relative des pentes et former pour ainsi dire un diapason, indiquant par graduation des teintes la structure du sol.

Les indications données ci-dessus ne sont valables que pour les points situés dans les zones photographiées, et il faut se souvenir que la carte n'est pas établie par zones couvertes complètes. La précision varie naturellement en fonction du nombre de points de repère et de films verticaux. Il faut observer, toutefois, que ceux-ci ne peuvent être multipliés au delà d'une certaine limite, car plus ils sont nombreux, plus la restitution est longue, alors que la rapidité d'exécution est une des principales qualités d'une carte de reconnaissance. Les programmes photographiques doivent être établis en faisant entrer en ligne de compte ces diverses considérations.

Il est inutile d'ajouter que la valeur de la carte est considérablement augmentée s'il peut en être fait une révision, même rapide, sur le terrain. Cette mise au point, déjà très utile lorsque la restitution est exécutée avec des appareils automatiques de précision, est encore plus nécessaire dans le cas de la méthode exposée, mais elle n'est malheureusement pas toujours possible.

Au Maroc, l'exactitude qui vient d'être indiquée est reconnue comme suffisante et la carte de reconnaissance au 100,000^{e} ainsi établie rend d'appréciables services.

Présentation de la carte. Les assemblages présentés au Congrès se composent de feuilles levées par phototopographie.

Le premier concerne la région de l'Oued el Abiel.

Le second, au 200,000^{e}, obtenu par réduction du 100,000^{e}, représente une portion du Grand Atlas, au sud de Marrakech; il lui est adjoint la même carte établie à l'aide de quelques itinéraires et complétée par renseignements.

La comparaison de ces deux feuilles au 200,000^{e} permet de se rendre compte des résultats obtenus par l'exploitation judicieuse des photographies aériennes.

THE INFLUENCE OF A FOURTEENTH-CENTURY MS. MAP OF BRITAIN UPON SIXTEENTH-CENTURY CARTOGRAPHY

R. A. PELHAM

Abstract

The author and date of construction of this map, which hangs in the Bodleian Library, are not known, but from palaeographical evidence it may be tentatively ascribed to the second quarter of the fourteenth century. The map is remarkable for its system of roads and mileages between towns, which, together with the emphasis on monastic buildings, leads one to suggest that it was possibly drawn up by monks for the benefit of pilgrims. The roads do not extend north of Hadrian's Wall.

The first printed map which bears the influence of this fourteenth-century example is a woodcut by Sebastian Munster in his *Ptolemy*, "*Geographia Universalis*," published at Bâle in 1540. The errors relating to Wales in the earlier map have not been corrected, and a lack of knowledge both of England and of English fourteenth-century script is shown by the curious misspelling of Guildford, Lewes, Hastings, Yarmouth, etc. Munster was a professor of Hebrew at Bâle.

George Lily's map (copper-plate) of 1546 shows a marked resemblance to the fourteenth-century map. Here, again, the old errors persist in Wales, but two new features are the straight N.–S. Lancashire coast and the incorrect position of Llandovery, which appears on the River Usk instead of on the River Towy. The source of the new errors seems to be a MS. map of Britain of *c.* 1540 which, revealing greater knowledge of England, especially the south-east, is obviously based on the fourteenth-century map. For example, rectangles off the Lancashire coast, which contained the names of rivers flowing from the Pennines, appear on the later map as islands, and the coastline has

been straightened to allow the name of the river to be attached, incorrectly, to the island.

A series of maps published between 1549 and 1589 appear to be either exact copies of the Lily map, or very slight modifications of it. The series is as follows:

1. 1549 Antwerp (Johannes Mollijns).
2. 1555 London (T. Gemini).
3. 1556 Rome?
4. 1556 Venice (Andreas Valvassorus).
5. 1558 Rome (Sebastianus a Regibus).
6. 1562 Venice (Ferrandi de Berteli).
7. 1563 Venice (Camotio).
8. 1589 Rome (Marcus Clodius).

Nos. 1 and 4 are from wood blocks, the rest from copper-plate. Also a map of Britain painted by Fra Ignazio Danti in 1570 on the panel of Eleanora of Toledo's wardrobe in the Palazzo Vecchio at Florence shows almost unmistakable influence of the Lily map.

It will be seen that the influence of the fourteenth-century Bodleian map persisted in a modified form until the close of the sixteenth century. It is important to add, however, that the Mercator map of the British Isles, published at Duysburg in 1564, and Humphrey Lluyd's map of Wales, published in an *additamentum* to Ortelius' Atlas in 1573, contain reasonably accurate representation of Wales, but had not, apparently, become sufficiently known to replace the erroneous specimens of the Italian school.

24 July

NEAR EARTHQUAKES

DR H. JEFFREYS

See *The Earth* (Cambridge University Press, 2nd ed., 1929).

Abstract

The paper dealt with the study of the waves sent out by small earthquakes, and recorded by instruments at distances up to about 800 km. It was found that six distinct pulses were traceable. They have received the names

$$P \quad P^* \quad P_g \quad S \quad S^* \quad S_g.$$

P_g and S_g are waves that appear to have travelled directly from the focus to the observing station, with velocities of about 5·5 and 3·3 km./sec.; P_g is a longitudinal wave, S_g a transverse one. P^* and S^*

have been refracted down into an intermediate layer, and travel in this layer for most of their paths. P and S have been refracted into a deeper layer still, and travel mainly in this. The velocities of the waves P_g and S_g in the upper layer agree with laboratory determinations of the elastic properties of granite. Geological evidence has also indicated a general granitic layer in the continents. The velocities of P and S are higher than can be attributed to any known material except dunite, a rock consisting chiefly of olivine. The properties of the intermediate layer transmitting P^* and S^* agree with those either of tachylyte or diorite; in the opinion of the lecturer the former is more probable from other considerations.

The times of the four indirect waves are delayed by the times lost in the transmission down and up again. These give measures of the thickness of the layers. The granite layer is about 10 km., the intermediate one about 20 km. thick. These estimates agree well with those indicated by several lines of investigation.

TRUE BEARING AND DISTANCE DIAGRAM

E. A. REEVES

See *Geographical Journal*, LXXIII (1929), pp. 247–8, and *R.G.S. Technical Series*, no. 5.

This diagram has been arranged primarily to enable surveyors abroad to orient the aerials of their wireless receivers. By its means it is possible to obtain approximately the true bearing, or azimuth, of one place from another, and also the great circle distance between them. It further provides data for plotting the arc of a great circle between any two points on a map. The diagram is a special adaptation of well-known methods of graphic solution for spherical triangles, previously employed by Chauvenet, Sigsbee, the author himself and others.

As first designed it consisted of two similar stereographic projections of a hemisphere, on the plane of the meridian of the station occupied, one with red parallels and meridians drawn on tracing paper, and the other in black on ordinary paper. These could be rotated about their common centre. When the polar axis of the one on tracing paper was set to the latitude of the station on the other, the intersection of the sets of curves on the two projections furnished means of measuring the sides and angles of spherical triangles, so that the bearing and distance between stations could be read off by means of suitable scales.

It was found in practice, however, that the use of two sets of curves was somewhat confusing, and in a later form one set of curves or coordinates was made to do duty for the two. In this case the curves are first used to represent parallels of latitude and meridians of longitude, and by their means the geographical position of the distant station is marked on tracing paper. Then the tracing paper, with the position marked upon it, is rotated so that its central vertical axis is set to the latitude of the station occupied. When this is done, the intersection of the curves at the position marked gives the true bearing and great circle distance of the other station.

This arrangement of the diagram answers fairly well, but tracing paper may not be easily obtainable by a surveyor abroad, nor does it lend itself readily to accurate measurement; so later on this in turn was discarded and, instead, a strip of paper or pointer pivoted at the centre of the diagram was employed. This is the final form which the diagram has now taken.

A little consideration will show that after the distant station has been plotted on the diagram, all that has to be done is to rotate the station through an angle equal to the angular distance of the occupied station from the North Pole; and this can readily be done by means of the pointer. As a general rule the accuracy obtainable by the diagram is more than sufficient for the purpose—generally to about one-third of a degree.

For convenience, parallels of the latitudes of the principal wireless stations are marked in red on the diagram, with their longitudes under the name of each station.

The stereographic projection has been employed, but any true central projection, of which the scale error is everywhere the same at the same distance from the centre, might have been used.

RETRO-AZIMUTHAL PROJECTION OF THE WHOLE SPHERE

A. R. HINKS

See *Geographical Journal*, LXXIII (1929), pp. 247–8.

Abstract

The Greenwich time-signal from the Rugby Station can be received in all parts of the world if the surveyor in the field has a suitable apparatus. But he must know the azimuth of Rugby at his station, in order that he may set his frame aerial. The accuracy required is

not great, and it is easily possible, by the use of Mr Reeves' diagram just described, to construct a retro-azimuthal projection of a new kind, which may prove useful to surveyors. It has some curious and amusing properties: thus, though it fulfils the conditions of a map projection, a map of the world cannot be drawn upon it, since it, so to speak, folds back upon itself. The two poles and the antipodes of the centre are concentric circles: and though the boundary is complete, there is a large vacant space within it which does not belong to the projection.

HACHURE IN RECENT CARTOGRAPHY

PROF. E. ROMER

The criticism of hachure relief in cartography is as old as hypsometric maps. As early as 1856 E. v. Sydow, writing about Papen's map of Europe, said: "The hypsometric map has few friends for there are few who understand the matter. Let us not cease to preach, for it is bound to remain in some form.... I myself am of the opinion that by introducing a colour-scheme for the lowlands I have inaugurated a new era in cartography, towards which the imposing *accretion of hypsometric material* itself leads us" (*Mitt. Geogr. Ges. Wien*, 1888).

I am happily able to say that I have behind me one-third of the century of the campaign against hachure relief, but am so far more fortunate than the critics who preceded me in that I have been allowed to see the time when the increase of hypsometrical material, foreseen by Sydow, allowed of the adoption of a universally binding resolution, in December 1913 at Paris, to the effect that the *International Map 1/M shall be a hypsometrical map*. Shading or hachures can be exclusively used only for parts not sufficiently surveyed, and such sections shall be marked "Provisional Edition."

A resolution of this nature meant practically the abolition of the hachure in cartographic works in the immediate future. Hence I was surprised to see hachure adopted in the post-war editions of the best-known geographical atlases, especially Stieler's and Schrader's. Recently too there has appeared the "Atlante Internazionale" (1928) issued by the *Touring Club Italiano* in Milan, a work which for several reasons must be regarded as the best and leading publication of world cartography.

The creation of such a great and entirely new work, based on hachure technique, 15 years after the Paris Congress, at a time when the publication of the 1/M map is in rapid progress, demands a definitive answer to the questions it raises, viz. "Shall this new pre-

cedent obtain the approval of science?" and "What inferences are to be drawn therefrom in regard to science and geographical instruction?"

Refraining from any general remarks I will at once proceed to an analysis of the "Atlante Internazionale." My aim was to define the degree of accuracy contained in the hypsometrical and morphological information of this atlas. The source of such information in hachure maps is naturally the spot-heights. "It is only when spot-heights," wrote Petermann (*Peterm. Mitt.* 1862), "are applied directly to the map, that the representation of relief becomes complete. It also obtains a definite basis and means of orientation, as does a map in general by its projection." The above reservation, which does not testify very highly to the graphic qualifications of the hachure method, has nevertheless retained its significance unaltered to the present day.

For my analysis I chose the relief of the Basin-Ranges in the west of the U.S.A., a region already sufficiently surveyed and of simple structure. The area embraces 102 one-degree trapezes between 36–43° N. and 109–124° W. For this area the "Atlante" gives 226 spot-heights (Stieler 243), a sufficient number for determination of the relative height in every trapeze. But the distribution of the points is in both cases so irregular that while in some trapezes we have as many as ten points, in 45 per cent. (Stieler) or 50 per cent. (Atlante Intern.) of one-degree fields, we find none at all, or only one, a deficiency which precludes any estimate of the relative height. As a further number of the trapezes have only valley or only peak spot-heights, we are deprived in those cases of any basis for indicating the relative height. This want of information is moreover observable in regard both to areas of poor relief and to those that are very rich in this respect. In the remaining trapezes, moreover, calculations of relative height usually give misleading results, owing to the choice of points not being characteristic. This error, as a rule of a negative character, increases in accordance with the rise of relative height. Accurate information as to relative heights is to be found only in 13 per cent. of the "Atlante" trapezes and in 19 per cent. of those in Stieler's Atlas.

But when we leave the domain of figures, in which these two hachure maps give us such incorrect information, and pass on to the other aspects, we find the results to be still less satisfactory.

In scales 1/2M to 1/5M the hachure drawing allows an individualization of forms only in exceptional cases. Even with scales like 1/2M to 1/5M it is possible to draw instructive profiles on the basis of the hypsometrical maps, while a hachure map is obviously quite useless

in this respect. Nevertheless it is possible to trace upon it the "up and down" of the relief, which I will define as the *rhythm of the relief.* A large number of studies of this rhythm have been made on the basis of maps analysed, whence it appears that the quotient of the rhythm in hypsometrical maps increases proportionally to the rise of the relative height, while in hachure maps this rhythm increases in low and flat areas. The *hachure method, which fails in the representation of the large features, indicates a multitude of minor forms.* Besides the question as to what are the guarantees of objectivity in such a small drawing, there can be no doubt that a technical facility of constructing the hachure relief in low and flat terrains tends greatly to efface the difference between large and small relief in a hachure map.

An analysis of other maps of the "Atlante" gave similar results; but in view of the details above I will confine myself to one or two points, taking as example first the map of the Cape of Good Hope. Here one of the most conspicuous features shown is the Roggeveld-Nieuwveld Range where occur heights[1] of 500–900 m. with normal gradients 4–6 per cent., attaining only in exceptional cases 10–22 per cent. On the other hand, the Lange Bergen Range, with heights[1] over 1000 m. and the Zwarte Bergen with heights[1] of 1500–1800 m. and average gradients of over 25 per cent., and often over 50 per cent., are here given a place incomparably less conspicuous than the first-mentioned range.

The map of Brazil likewise provides a serious warning to cartography. In the morphological representation of this area the "Atlante" worked on entirely different lines from Stieler. Rejecting the "sierra" in the strict sense of the word, according to Stieler's conception of it, and rightly—in my opinion—the Italian cartographers went over to another extreme morphological representation of Brazil, giving it the character of distinct plateaus with steep edges.

The "Atlante" based its map of Brazil on a new 1/M map published by the *Club de Engenharia*, which was unknown to the compilers of Stieler's. The authors of the "Atlante," evidently influenced by the unusual vastness of the areas embraced by the contour-line of 900 m. in the 1/M map of Brazil, have arrived at a synthesis of wide plateaus interrupted only by steep borders. The authors of the "Atlante" have not realized that the 900 m. contour-line is the highest one in the map of Brazil, and that therefore the form of this contour-line does not give any indication as to the morphology of the land, which rises often to 2000 and 3000 m.

[1] *i.e.* relative heights.

The detailed analysis will justify the following conclusions:

(1) Plastic information as to morphological conditions, which can not only be subject to a quantitative estimation, but in which also the degree of exactitude can be immediately recognized, is only given by a hypsometrical map.

(2) In regions insufficiently surveyed, a hypsometrical map already reveals the degree of our knowledge of the matter, while the hachure method, by its very nature, cannot but conceal these important differences.

(3) The total morphological information supplied by hypsometrical maps, as compared with that supplied by hachure maps, increases with the absolute and relative height of the region. On account of the increase of information given by hachure maps in parts of low terrains and those of moderate relief, the recognition of a well-pronounced relief and a high terrain becomes more difficult in them.

(4) A comparison of the two greatest hachured cartographical works demonstrates the evident recent decline of technique in this direction and constitutes a clear warning against the formation of a new generation of hachure cartography.

I beg you to support a motion somewhat similar to that of Admiral Ernesto de Vasconcellos, concerning a standardization of cartographical methods, applied to geographical maps of all scales; and I therefore propose that a commission be elected for the investigation of both methods (contours and hachures), with special regard to small scale maps (1/200,000 and below) for both scientific and didactic purposes.

M. EMM. DE MARGERIE fait remarquer que la lutte entre la hachure et les courbes remonte à l'origine même de la cartographie scientifique, au début du siècle dernier. Personnellement, il ne croit pas que le second procédé puisse convenir à tous les types de cartes, et en particulier aux cartes à petite échelle, où la continuité des accidents et leur importance relative offrent beaucoup plus d'intérêt pour la majorité des lecteurs que leur altitude absolue. Il suffit de comparer, par exemple, la carte de France contenue dans l'*Atlas Universel* de Schrader et Vivien de Saint-Martin aux celles du *Times Atlas of the World* de Bartholomew pour se convaincre de la richesse beaucoup plus grande de la première. La crise qui traverse l'art de la hachure soulève une question d'habileté artistique beaucoup plus que de science.

PROF. E. ROMER said that it was very difficult to reply to the *apologia* for hachure developed by M. de Margerie. He agreed completely with his eminent opponent that hachure adds much to the eloquence and plasticity of maps. But being the last speaker in this section he regretted that there was no time to discuss and demonstrate the objectivity of these plastical effects as shown by hachured maps. In his opinion the morphological synthesis expressed by hachure was in the highest degree subjective, and even in large-scale maps (1 : 200,000) never gave graphic representation sufficiently comparable—as between one part and another even of the same section—or proportional to the morphological and hypsometrical features.

SECTION B. 19–24 July

19 July

THE PHYSIOGRAPHY OF THE SAN JUAN MOUNTAINS OF COLORADO

PROF. WALLACE W. ATWOOD

THE SAN JUAN district of south-western Colorado is one of magnificent mountain forms. It is a region of great scenic beauty. Most of the summit area is from 12,000 to 13,000 ft. above the sea and there are more than 200 peaks that rise to elevations above 13,000 ft., and at least 13 peaks that rise to elevations of over 14,000 ft. Near the summits broad, open amphitheatral basins are found where snows formerly collected and were compressed by their own weight into glaciers. Canyons 3000–4000 ft. deep are common, and at a few places the depths of the canyons measure 5000 ft.

In winter this lofty mountain region is mantled with snow that attains in places a depth of 20 ft. The contours of the landscape are softened and the rich colours of the summer season are replaced by the delicate blue-gray shadows among the great snow banks. During the summer bare rock surfaces and perennial snow fields dominate in the summit areas; short grasses characterize the alpine pasture lands; forests clothe the middle slopes of the mountains; tall grasses grow most naturally in the valley lowlands and the blue-green of the sage-brush gives character to the semi-arid surfaces of the bordering plateaus. The mountain landscape contains thousands of beautiful lakes and a number of artificial reservoirs, where the waters from the melting snows and the heavy rains are held in reserve for use in the bordering lowlands during the latter part of the growing season.

White men were first attracted to the San Juan Mountains by reports of great mineral wealth and through careful search for many years rich deposits of gold, silver, lead and zinc ores have been discovered. The cities of Silverton and Telluride both suggest the mineral wealth of the region. Mining towns sprang up in the early eighties of the last century and continued to prosper for a few decades and then passed away. A few have survived and are still the centres of active mining operations in these mountains. Most of the forests have been set aside as national reservations and they furnish timber for the local ranchmen and for use in the mines. These reservations are used as grazing districts; and the total carrying capacity has been estimated for cattle and horses at 69,000 and for sheep and goats at a little over

460,000. In the lowland valleys ranchmen have built homes and appropriated the alluvial lands for the production of hay and alfalfa. They have fenced in the pastures near their homes and the fields which they cultivate, so that they may care for their livestock during the winter season. The San Juan Mountains have long been an attractive vacation ground, and with the coming of the automobile and improved roads more and more tourists are entering the region and erecting temporary camps along the stream courses during the summer season.

The Late Geological History

At the close of the Mesozoic era and the opening of the Cainozoic era there were mountain-making movements which affected the entire Rocky Mountain province of North America, and the great dome which was then formed in the San Juan area was at once subjected to vigorous erosion. As the mountain mass rose erosion began, and as the great dome was more and more deeply dissected, a mountain topography must have been produced, and those mountains may be thought of as the first generation of the San Juan range. During the period of mountain growth, there was some vulcanism. Many porphyritic intrusions and the deposition of the great volcanic tuffs which made contributions to the Eocene or Ridgway till, date back to this period. The Eocene till indicated that, during the dissection of these early San Juan Mountains, ice formed in the range and descended to the bordering lowlands. Possibly ice formed in neighbouring ranges and approached the San Juan Mountains, and possibly there were distinct glacial epochs in that period of glaciation.

After the retreat and disappearance of the early Tertiary ice, stream erosion continued, and the western portion of the San Juan Mountain area was reduced to a surface of slight relief which may be thought of as a peneplain. This peneplain bordered on the west a higher area of mountainous character, which supplied the material for the Telluride conglomerate. The deposition of gravels upon this peneplain surface was probably due to some uplift and rejuvenation of the streams in the eastern portion of the range. After the deposition of the Telluride conglomerate there was further erosion in the range, and then came the three great epochs of vulcanism, the San Juan, the Silverton, and the Potosi. During these epochs a great volcanic plateau was developed. By this time the Miocene epoch had been reached and possibly passed, and with the quieting down of volcanic activity began the erosion and dissection of the volcanic plateau. During this period

of dissection another generation of San Juan Mountains was carved, this time out of volcanic debris and great lava flows. These mountains may be referred to as the second generation of San Juan Mountains.

The Physiographic History

When the work of building up the great volcanic plateau closed in late Miocene time and the dissection of that plateau was begun, the last chapter in the physical history of the region was inaugurated. Streams cut deep valleys into that plateau and in time uncovered the old mountain forms and erosion surfaces which underlay the volcanic debris in portions of the range. In this way the Needle Mountains which had appeared at various times in the geologic history as monadnocks were resurrected and they came again, because of their superior resistance to erosion, to stand out as monadnocks above a new erosion surface which was being developed in the Pliocene period.

Over much of the summit area of the San Juan Mountains there are remnants of a peneplain on which stream gravels and old soils and old stream courses have been identified. If the volcanic debris which was removed during this cycle of erosion were replaced, it would probably rise 3000 to 4000 ft. above the present summits of the range.

This summit peneplain in the centre of the range is at elevations of over 12,000 ft. above the sea. It was not developed at that horizon, but since development it has been uplifted. To the east in the San Luis valley, this same erosion surface is buried beneath hundreds of feet of lava and alluvium. It can be traced to-day in the field from the summit areas in the mountain region into the valley and to considerable depths below the more recent filling in that valley. In this portion of the area the peneplain appears to have been depressed. Local faulting strengthens this conclusion.

With the re-doming of the area, which involved the warping or doming of the summit peneplain, another cycle of erosion was begun. Valleys were again formed, and in these valleys snows collected which in time formed glaciers that advanced to the lowlands bordering the range. These earliest Pleistocene glaciers, now called the Cerro glaciers, retreated and disappeared. The range continued to be uplifted, and the streams were so rejuvenated that they cut great canyons below the broad troughs occupied by the Cerro glaciers. Again climatic changes favoured the formation of ice among the summits, and that ice (Durango glaciers) descended through the main canyons to the foothills and later retreated and disappeared. The canyons were

still more deeply cut into the mountain mass, and then climatic conditions favourable for glaciation once more returned and the Wisconsin or third series of Pleistocene glaciers formed and descended through the great canyons, nearly as far as those of the Durango stage. These glaciers have now disappeared, and there is no true glacier ice remaining in the region to-day, but the streams are vigorously dissecting the mountain mass to still greater depths. The vigour of that work is illustrated in many a sharp V-shaped notch cut below the depth of ice action. The debris taken from the mountain area is being distributed along the great valleys leading away from the range. The ice gouging in the three successive Pleistocene stages and the vigorous stream work during the interglacial intervals and since the last melting away of the ice suggest somewhat continuous mountain growth in this region during late geologic time.

Correlation with the Plateau Region to the West

Bordering the San Juan Mountains to the west and south-west is the Colorado Plateau into which has been cut that magnificent gorge known as the Grand Canyon of the Colorado. It was while studying the physiography of this plateau district that Major J. W. Powell conceived the idea of the cycle of erosion and he outlined the sequence of events which should normally follow during a cycle of erosion. Later Captain Dutton made extensive geologic studies in this part of the country and he recognized the great erosion surfaces and evidence of distinct cycles of erosion in the region. W. M. Davis and Herbert Gregory have made other contributions which throw important light upon the physiographic history in the plateau areas bordering the Colorado River and lying to the south-west of the San Juan Mountains.

The correlation of the events which have occurred in the physiographic evolution of the mountain region with those which have characterized the late history of the plateau region presented a most fascinating problem. Near the close of the period of field seasons, expeditions were taken from the mountain region far out over the plateau and a working hypothesis was formulated, which should be tested by further correlation studies. The summit peneplain of the mountain region which could there be determined to be of mid-Pliocene age was traced far out into the plateau region. This erosion surface continued to truncate the structures and it carried on its surface the unmistakable evidence in gravels and boulder deposits that characterized the surface in the foothill region about the moun-

tains. Below this widespread summit peneplain are the lower but broad erosion surfaces of the plateau and the still lower and younger canyons and gorges. There were numerous areas that would fit very happily into the upland valley or park stage of erosion which is so well shown in the mountain regions of Colorado, and the valleys and canyons of the plateau appear to record at least two later cycles of erosion.

The evidence all pointed to the conclusion that the great canyons of the plateau are all of about the same age as the great canyons of the mountain region and if that proves from further study to be true, that most magnificent of gorges in the North American continent has been developed during and since the beginning of the Pleistocene period. We are certain that during the ice age the amount of rainfall and snowfall in the mountain regions and in the plateau area were much heavier than they are to-day. The waters from the falling rain and from the melting snow and ice may have hastened the work of erosion during each of the stages of glaciation, and during the periods of de-glaciation the work may have progressed about as it is progressing to-day. It is suggested, therefore, from a study of the two neighbouring regions of distinct physiographic types, that in a broad way their physical histories during late geologic times have been similarly punctuated. The evidence of physical events recorded in the topography of the mountains can be matched by similar evidence in the topography of the plateau region, and the events in these adjoining regions can be quite closely correlated.

MR BERNARD HOBSON asked what evidence there was for the Eocene age of the early glaciation. Were there fossiliferous overlying beds, and were striated boulders, held to be of Eocene age, found in the till?

PROF. W. W. ATWOOD, in reply, said that striated stones were very common in this drift deposit. The overlying Telluride conglomerate had associated with it layers of volcanic ash in which plant remains, which had been identified as of Oligocene age, had been found.

NOTE. *The following eight papers (pp. 157–168), of which abstracts only are given here, have been handed over to the Commission on Pliocene and Pleistocene Terraces.*

RAISED BEACHES AND VARIATIONS OF SEA-LEVEL

PROF. J. W. GREGORY

Abstract

The correlation of the Scottish raised beaches is part of a west European and world-wide problem. The three chief Scottish beaches are the 25 ft., 50 ft. and 100 ft., but these figures express only general

averages. Each beach varies in height locally, while their levels overlap, and afford no certain identification. The 100 ft. beach was no doubt contemporary with the last great advance of the glaciers, for it is in a few places in contact with morainic deposits, as in Glen Rosa, Arran, and near the head of Loch Fyne. It is later than the boulder clay. The 25 ft. beach is in some places Neolithic; in others Azilian, with, according to Breuil, Magdalenian influences at Campbeltown; and there are suggestions that it is post-Neolithic at Loch Ryan. The local development of the beaches is also shown by their absence from some parts of the Scottish coasts, as from the Orkneys, and although conspicuous on the eastern shore of the Minch, they are absent from its western side, except for a low level beach at Loch Maddy. These variations indicate that the raised beaches are due to local rise and fall of the land. This conclusion is consistent with the evidence of other coasts examined by the author. In Equatorial Africa the raised coral reef at Mombasa descends northward to 40 ft. at Mambrui, and then to sea-level; and it is reported to rise to 200 ft. further north. At Zanzibar the raised reefs are at 30 ft.; they rise to 130 ft. at Lindi, and still further south are at 26 ft. in Mozambique. On the opposite coast of Africa in Benguella there are no corresponding raised reefs or beaches, and in South Africa the conspicuous 20 ft. beach is of such late date that on the glacial control theory it requires a great recent increase in the glaciers, of which there is no adequate evidence. In New Zealand the beaches at the southern end are as conspicuous as in Scotland; but they disappear northward, and they are locally and irregularly developed in Australia. Thus on the coast of Victoria, where they should be well preserved, they are very variable in height and extent, and the reported more regular higher terraces are based on kitchen-middens. These facts, combined with the irregularity of raised reefs and terraces in the islands of the Pacific and the Eastern Archipelago, support the conclusion that the existing raised beaches are due to local variations in level of the land, and not a general rise or fall of the sea.

PROF. E. DE MARTONNE, le Président, se félicite de voir la discussion sur les Terrasses ouverte par la substantielle communication du Prof. Gregory. Celui-ci a pris position nettement contre l'explication eustatique. Avant de donner la parole aux personnes qui désireront présenter des observations il est peut-être bon de faire une remarque, ne fût-ce que pour orienter la discussion: l'explication eustatique n'est nullement opposée à la constatation de mouvements du sol affectant les terrasses; elle ne requiert comme preuve qu'une chose, la présence de terrasses à des niveaux relatifs exactement pareils, dans des régions éloignées et de constitution géologique différente.

MR BERNARD HOBSON, inclining to the view that some raised beaches may

be due to a variation of sea-level and others to local movements of the land, mentioned that there was a raised beach in the immediate neighbourhood of Wellington, New Zealand, which was raised at a known date on the occasion of an earthquake, the year of which, if he remembered rightly, was 1850.

PROF. M. GORTANI: Ce que M. Gregory vient d'exposer correspond à ce que j'ai constaté pour l'Italie. Le problème est cependant très compliqué, et on ne pourra le résoudre que d'après un grand nombre de nouvelles recherches étendues à des régions les plus nombreuses qu'il sera possible. Seulement alors pourra-t-on établir s'il n'existe que des variations locales de niveau, ou si elles ne s'ajoutent, en les masquant souvent, à des véritables mouvements eustatiques.

PROF. DOUGLAS JOHNSON, referring to Prof. Gregory's remarks concerning Daly's 20 ft. terrace, pointed out that on the Atlantic coast of North America terraces of different origin, some of them non-marine, and of different ages, had been taken to represent the 20 ft. level. The last movement in America appeared to be one of submergence, as proved by the character of the salt marsh deposits, and not one of emergence as implied by Daly's theory of a 20 ft. eustatic drop of sea-level. In the opinion of the speaker it was reasonable to suppose that there had been both eustatic shifts of sea-level and differential movements of the land. The whole problem was to discriminate between the two, an extremely difficult matter. It was not enough, as suggested by the President, that beaches at the same level should be found at widely different points. Such coincidence was practically inevitable in the case of beaches, raised by differential land-movements, since these are numerous in many parts of the world. What is needed to establish the eustatic origin of an elevated beach is continuity of uniform elevation over an area too vast to be reasonably interpreted as the result of broad uniform uplifting of the land.

DR MARIE POLACZEK, by way of contribution to the hypothesis that the terraces are due to tectonic movements in a number of cases, said that in the plain of Podolia, which had not been subjected to glaciation, but where evidence of rather recent tectonic movements was forthcoming, terraces of the same altitudes as those cited for Scotland by Prof. Gregory had been observed, viz. 35–30 m. (100 ft.)—20–15 m. (50 ft.)—7·5–6 m. (25 ft.). The suggestions put forward by Prof. de Martonne and by Prof. Stefanini as to climatic causes and effects were borne out in the case of Podolia. The terraces of the watercourses and of the dry valleys were masked. A climatic change had affected both their topography and the character of their deposits.

OBSERVATIONS ON THE ANALYSIS OF QUATERNARY TIME

H. C. DARBY

Abstract (*see* NOTE, *p.* 157)

The paper is concerned with some of the difficulties involved in Prof. Depéret's elucidation of Quaternary history. These difficulties are of two kinds:

(1) The more general aspects—the questions of Eustatic movement and of river terracing.

(2) The discordances revealed by a consideration of regional detail, with special reference to the English Channel.

The general scheme of Prof. Sollas's interpretation of the work of Prof. Depéret is questioned and an attempt made to estimate the contribution of the latter to the problem of Pleistocene classification.

FLUVIATILE AND MARINE TERRACES OF ITALIAN AFRICA

PROF. G. STEFANINI

Abstract (*see* NOTE, *p.* 157)

The study of terraces presents peculiar difficulties in Africa, where one has no help either from the possibility of a correlation with the glacier deposits of a known age, or the support of palaeontologic facts, the Pleistocene fauna of these regions not having yet been systematically studied. At best, we have only very general and not very exact information about these regions, and it is difficult to correlate.

I have, nevertheless, tried to unite all the facts which I have been able to find, in a not very extensive, but very scattered bibliography, on the terraces of Cyrenaica and of Tripoli, and also on the Erythrean Colony, and I have made a summary of all I have myself been able to observe during my journeys in Italian Somaliland, rather with a view to obtaining a starting-point for new researches than of arriving at conclusions which would be premature at the present time.

The calcareous massif of Cyrenaica is cut by three large plateaus or terraces; those of Cyrene (600 m.) and of Barca (250–300 m.), which are Tertiary (perhaps Miocene), and that of Benghazi (under 100 m. in height), which can be divided into at least two levels, which are probably both Pleistocene. Nothing similar may be found in Tripolitania, where only a marine Pleistocene deposit is known, raised in Jefara from 8 m. to 30 m. above sea-level. The rare fluviatile terraces observed in Cyrenaica and in Tripolitania are Quaternary, perhaps corresponding to the so-called Pluvial period. Generally of slight elevation, they are ordered in a single series.

Terraces cut in crystalline rocks and covered by limonite formations (supposedly very ancient, perhaps pre-Triassic) were observed in Eritrea, on the high land. Along the actual coast there is a coralligenous Pleistocene *panchina*, which forms the wainscot of the coastal plain and of the islands from the northern limits of the Colony to

Assab. It does not exceed 10–20 m. in height, but occasionally it seems to reach to 40 m. or more. It is possible that it corresponds to several levels. Round the inner basin of Dancalia two cycles of terraces are distinguished, the first and the more elevated one (300 m.) is cut in at least three levels, in conglomeratic formations, and has been attributed to the pluvial period; the second begins with a coastal marine fossiliferous ridge, which indicates the action of waters with normal salinity and is situated nearly at sea-level, and it continues with three other terraces cut in salt and gypsum, and de-grading from zero to the bottom of the basin (140 m. under sea-level).

In Somaliland, a level of raised beaches is known on the coast of the Gulf of Aden and on the Indian Ocean coast, except between Itala and the mouth of Juba River where a very recent submersion seems to prevail. The raised beaches continue through Jubaland. The torrents which open to the Gulf of Aden have an evident triple apparatus of high terraces at their opening on to the plain (70, 40 and 10 m. on thalweg); the first, *i.e.* the oldest, terrace is prevailingly calcareous or gypseous, the second has altered and decalcified pebbles, the third and more recent has unaltered calcareous white pebbles.

The torrents opening to the Indian Ocean from the Italian Northern Somaliland (Darror, Nogal, etc.) have a single terrace (from 10 m. to 20 m. in height). Along the lower Webi Shebeli the terraces seem to fail; perhaps they are submerged by the recent deposition of alluvium, in consequence of the continual elevation of the base level. Terraces can be observed along the Juba River, and result from two different cycles: a series of low quaternary terraces (about 10 m.), which may be followed as far as the river mouth, is cut in gypseous and calcareous clayey deposits, and a more ancient series of pebbled tracts has been deposited on the high lands that edge the river between Dolo and Bardera, nearly 100 m. in height above the thalweg.

Although, as I have stated above, one cannot for the moment draw conclusions from these researches, some facts seem to me outstanding:

1. Terraces, whether they be marine or fluvial, are a widely spread phenomenon in Italian Colonies, both in North and in East Africa.

2. Terraces have been observed also in the high and middle valleys of Mijurtin (Northern Somaliland), as in the Darror and Nogal valleys, which are hydrographically discontinuous on account of their inferior branches; so it would be impossible to ascribe these and similar terraces to changes of base level, and the most likely explanation lies in a change of climatic conditions.

3. There is a part of Somaliland where the proofs of a subsidence (lack of marine terraces, alluvium of rivers crossed by artesian springs for more than 100 m. below the level of the sea) are accompanied by the lack of fluvial terraces; this may be explained by the rising of the base level, in accordance with the hydrographic conditions of the principal river, the Webi Shebeli, which has been prevented by the advance of the dunes from reaching the sea at a relatively recent epoch, which led to the aggradation of all the valleys.

PROF. J. W. GREGORY congratulated the Section on this valuable contribution. He fully agreed that the three great level surfaces in Cyrenaica were due to denudation, and remarked the absence of features at corresponding levels in Tripoli. Evidence of recent great uplifts in Somaliland was given by the collections of Mr Farquharson which included corals of recent species at levels of 800 ft. (250 m.). At Kismayu a considerable uplift had been claimed from the occurrence of caves in a Miocene limestone, and he asked whether Prof. Stefanini had any evidence in support of this claim. Prof. Stefanini's view that some of the terraces were relics of former climatic conditions was supported by evidence from Kenya Colony.

PROF. E. DE MARTONNE: La communication du Prof. Stefanini nous apporte une très heureuse orientation sur les terrasses littorales de l'Afrique du Nord-Est. Leur étude détaillée pourra conduire à des conclusions que rien ne permet de prévoir en Europe. Dans les pays arides, les surfaces d'alluvionnement sont naturellement en pente plus forte que dans les pays humides. Les terrasses signalées par le Prof. Stefanini pourraient être (particulièrement dans la Somalie) des glacis de piémont aride découpés pendant des périodes de climat plus humide.

LES TERRASSES DE LA PLAINE ROUMAINE

PROF. G. VÂLSAN

Résumé (*see* NOTE, *p.* 157)

L'étude des terrasses du Bas-Danube et de ses affluents roumains permet de suivre de près l'évolution morphologique de la plaine roumaine et apporte des preuves décisives à l'appui de l'hypothèse des mouvements récents de cette plaine (Cobalcescu, Mrazec, de Martonne).

Le long de la plaine roumaine, le Danube est accompagné par un système de terrasses assez compliqué, dont deux sont constantes et ont une valeur morphologique.

La terrasse supérieure, très développée en Olténie, et se trouvant à un niveau nettement inférieur à celui de la plaine formée par des dépôts lacustres levantins, est la première trace de l'activité du fleuve à travers la plaine roumaine. Elle montre que le Danube actuel a fait son apparition dans cette plaine à une époque post-levantine, em-

pruntant le lit d'un Pré-Danube qui avait ses sources dans le massif des Portes de Fer, et s'était déjà creusé un lit assez profond au contact des dépôts levantins avec les formations plus anciennes du plateau bulgare.

Cette terrasse supérieure disparaît, comme terrasse, à l'embouchure de l'Argesh, où elle est encore dominée par la plaine de 25 m. et domine le fleuve de 45 m. Vers l'aval, la basse altitude de tout le reste de la plaine prouve qu'à l'époque de cette terrasse (quaternaire moyen: *Eleph. primigenius*, *Eleph. antiquus*, *Camelus alutensis*), sur la plaine orientale il existait encore un vaste marécage, dernier vestige du lac levantin.

La terrasse inférieure, de 20–15 m. plus basse que la précédente et se rapprochant du niveau du fleuve vers l'aval, prend une grande extension dans la plaine orientale et permet de suivre les étapes d'assèchement du marécage existant à l'époque de la terrasse supérieure. Ainsi un grand bras du Danube de cette époque traversait la steppe actuelle du Baragan (Murgoci) et la plaine de Braïla, pour rejoindre la plaine basse du Sereth. C'était une immense *Balta*, aujourd'hui couverte par une grosse couche de loess—remaniée à son tour par l'activité éolienne—qui laisse à peine deviner les grands traits morphologiques du pays.

Le long de toutes les rivières affluentes roumaines, on peut suivre, jusqu'à la zone karpathique, des terrasses correspondantes à celles du Danube. Mais tandis que les rivières de l'Olténie sont suivies par des terrasses plus ou moins parallèles au cours actuel, toutes les rivières valaques montrent, à leur sortie des collines, un large déploiement de terrasses en éventail, indiquant que ces rivières ont récemment changé de direction de 75–120°, toujours vers l'Est. Ce phénomène est dû à l'affaissement continu de la plaine roumaine, qu'on peut suivre, grâce à l'étude des terrasses et des anciens cours abandonnés, depuis le quaternaire moyen jusqu'à nos jours, aussi bien dans son allure générale que dans ses variations locales.

PROF. E. DE MARTONNE: Les observations de M. Vâlsan sont d'un grand intérêt, car elles se rapportent à un pays où il semble possible de constater à la fois des terrasses en rapport avec des mouvements eustatiques, des terrasses dues à des mouvements du sol et des terrasses du genre de celles que M. Chaput a appelé terrasses polygéniques. On a signalé le premier genre de terrasses sur le Pruth et le Sereth (Sevastos). Cependant, je dois faire remarquer que le relèvement du niveau de la Mer Noire au Quaternaire, auquel il est fait allusion par M. Vâlsan, n'est pas comparable aux mouvements eustatiques; il s'agit d'une mer intérieure fermée, qui se trouvait, comme la Caspienne actuellement, au-dessous de niveau des Océans, et qui a été envahie par les eaux océaniques à la suite de la formation du Bosphore et des Dardanelles. Il est probable que quelques-unes des terrasses de la

plaine roumaine pourraient être interprétées comme terrasses polygéniques. Mais, dans l'ensemble, l'affaissement de cette région pendant le Quaternaire récent lui-même ne paraît pas douteux. Les coudes des rivières affluentes du Danube ont été interprétés comme indiquant l'attraction persistante d'une aire d'affaissement située entre Buzău et Galatz. M. Vâlsan a non seulement prouvé qu'il en est bien ainsi, mais a tracé de façon définitive les cours successifs suivis par chaque rivière se déplaçant vers l'Est. Il y a peu d'exemple d'étude aussi décisive à ce point de vue.

20 JULY

THE RESULTS OF THE INVESTIGATION OF RIVER-TERRACES IN BOHEMIA

DR V. J. NOVÁK

Abstract (*see* NOTE, *p.* 157)

All rivers of Bohemia unite in the Labe (Elbe), which therefore serves, and has done since the Pliocene, as the base level of erosion for them. The uncertainty concerning the development of this river in Saxony prevents the recognition of the ultimate cause of the formation of river terraces along its upper course in Bohemia as well as of those along the other rivers of the country. On the valley-slopes of the Labe between Litoměřice and Děčín six to seven steps may be distinguished from 12 to 230 m. above the present surface of the river. Platforms of relative heights generally somewhat lower have been recognized round the mountain Říp and on the lower course of the river Vltava (Moldau), which must be considered as the chief source of the Labe. In the southern environs of Prague plant remnants indicating Miocene age have been found in deposits belonging to the highest platform four to five steps up from the river-level. The lower terraces can be regarded as Quaternary on the evidence of mammal bones, occasionally associated with their sediments, or of the Scandinavian drift (in northernmost Bohemia). The highest step but one is most probably of Pliocene age.

Among other rivers the most thoroughly investigated are the Ohře (Eger) by Engelmann, and the Berounka (Beraun) by Purkyně. The terraces of the first-named river show that it flowed, not very long ago, through a valley, now dry, to the actual valley of the Bělá. They are, on the whole, not simply connected with the terraces of the Labe, as is usually the case with terraces of tributaries of a main river in lowland, but seem to depend on the occurrence of alternating hard and soft rocks. On the Berounka, in the vicinity of Plzeň, one would suggest the same reason for the origin of terraces, while those on its lower course appear as continuation of the terraces of the Vltava.

The terraces of the Little Labe, as we call the chief tributary of the main river originating in Krkonoše (Giant Mountains), have been investigated chiefly by Dědina and Sokol. But there remains a gap of some 50 km. between them and the terraces of the Great Labe in the environs of Říp for which no results of such studies have been published as yet. Relative heights of platforms on both sides of this gap show marked discrepancies, so that their mutual relation is not clear.

The oldest of the aforesaid river gravels (Miocene) were evidently laid down before the deep valleys, now so characteristic of many parts of Bohemia, had been excavated. Like the quartzites, occurring here and there at still greater heights, they are situated on elevated plains or a little below them, partially, it seems, in tectonic hollows. It is highly probable that in their time the hydrographic unity of Bohemia did not exist. The probably Pliocene deposits accompany, in the main, the actual rivers, though often forming broad platforms above the valleys, but distinctly below the elevated plains.

DR FRANT. VITÁSEK, remarking that Dr Novák's discussion of river terraces was limited to Bohemia, said that he himself had begun an investigation of those in Moravia and in Western Slovakia, and hoped that he might say a few words relating to the preliminary results of these studies. Up to the present it was possible to distinguish three Quaternary terraces along the courses of the rivers Dyje, Morava, Váh and Hron: from 8–15 m., from 30–35 m., and from 70–80 m. above the alluvial deposits. The highest terrace on the border of the Bohemian Massif is situated near the level of the plain which was formed by marine abrasion in the Miocene period. The terraces have been studied in detail by Dr Říkovský in the neighbourhood of Brno. So far, six terraces have been found at heights of 10, 20, 40, 60, 90 and 120 m. above the alluvial deposits.

DR NOVÁK, in reply, said that he had examined the terraces of Southern Moravia himself, and that to him the most striking feature was the close concordance of their relative heights with those of the Danube near Vienna and in the canyon of the Iron Gate. Another puzzling fact was the close relation of their heights to those of several rivers in France and other countries, as had been noticed by Gen. De Lamothe and Schaffer. As Prof. de Martonne had justly remarked on the previous day, there could be no question of corresponding eustatic movements of the Black Sea and the Ocean as the cause of these coincidences.

LES TERRASSES DE LA VISTULE MOYENNE

PROF. S. LENCEWICZ

Résumé (*see* NOTE, *p.* 157)

La vallée de la Vistule moyenne comprend quatre systèmes de terrasses. Les terrasses supérieures (IV$^{\text{èmes}}$) s'élèvent de 45 à 35 m. au-dessus du niveau du fleuve; leurs altitudes, ainsi que les hauteurs

relatives, descendent vers l'aval. Le système suivant (IIIème, moyen) s'abaisse dans la même direction et son hauteur relative varie de 22 à 15 m. Les deux systèmes sont taillés dans le plateau morainique. Ils forment les grandes plaines à surface, tantôt composées de moraine désagrégée, tantôt couvertes d'anciennes alluvions (sables à cailloutis). Dans les environs de Plock la terrasse supérieure a subi l'envahissement d'une oscillation glaciaire dont l'empreinte s'est conservée sous aspect des moraines frontales, des osars, des lacs.

La faune des mammifères (*Elephas antiquus*, *Rhinoceros Merckii*, etc.), découverte dans les environs de Varsovie, nous permet d'attribuer l'âge de ces terrasses au Quaternaire moyen. Ainsi nos terrasses supérieures correspondent aux basses terrasses de l'Europe occidentale et des régions subalpines, les unes comme les autres étant würmiennes. Cette corrélation est évidente même sans preuves paléontologiques, lorsqu'on pense que nos terrasses n'auront pu commencer à se former avant le recul de la dernière glaciation, tandis que celles-là se développaient durant le Quaternaire entier. Nous arrivons aux mêmes conclusions par la comparaison des hauteurs relatives des terrasses, mesurées au-dessus du niveau des fleuves.

		Vistule moyenne	Rhône, Rhin, Moselle, Loire, Seine d'après de Lamothe et Chaput	
			100–90 m.	IV haute terr.
			60–55 m.	III moyenne terr.
Würmien Bühl pro parte	terr. supérieure IV	45–35 m.	40–35 m.	II basse terr.
		Elephas antiquus, *Rhinoceros Merckii*		
	terr. moyenne III	22–15 m.	20–15 m.	I basse terr.
Ancylus	terr. inférieure II	5–10 m.		
Littorina	terr. d'inondation I			

La corrélation de nos terrasses avec celles de la France s'explique par le fait que la Vistule coula alors à l'Ouest vers la mer du Nord, par le système des chenaux pro-glaciaires appelés *pradoliny* (*Urstromtäler*). Ainsi ces terrasses se sont formées sous l'influence des mêmes facteurs qui ont changé le niveau de base des fleuves français.

Les terrasses inférieures (IIèmes) de la Vistule n'ont pas de corrélation à l'Ouest de l'Europe. Elles se formaient dans les temps postglaciaires lorsque la Vistule trouvait son niveau de base dans le lac d'*Ancylus*. Ces terrasses se distinguent des précédentes par leur hauteur relative qui monte vers l'aval (de 5 à 10 m.), ainsi que par leur structure alluviale. Toute leur hauteur constituent les sables, soubassés par les limons et couverts, par endroits, de tourbes. Ces alluvions descendent beaucoup au-dessous du fond de la Vistule et

indiquent une période de stagnation érosive qui se produisit à l'époque du soulèvement d'*Ancylus*.

L'abaissement du niveau de la base à l'époque de *Littorina* renforce l'érosion et la Vistule descend sur les terrasses d'inondation (I^res^). L'enfoncement du fleuve commence par l'aval, en conséquence la hauteur des terrasses inférieures (II^èmes^) diminue vers l'amont. Leurs sables ne sont plus envahis par les inondations et les grandes dunes peuvent se développer. L'amélioration du climat propre à l'époque de *Littorina* facilite encore la formation des dunes.

M. CHAPUT croit qu'il y a des inconvénients à employer les termes de basses terrasses, moyennes terrasses, etc. dans les comparaisons entre pays différents. Le tableau synoptique de M. Lencewicz, où les basses terrasses françaises paraîtraient identiques aux terrasses supérieures polonaises, donnerait l'impression de différences, alors que les analogies des faunes à des altitudes relatives analogues suggère plutôt l'idée d'une évolution semblable dans les deux cas, et c'est d'ailleurs là l'impression de M. Lencewicz. Il semble que, si l'on désignait les terrasses par leurs altitudes relatives, cela serait préférable. D'autre part les "basses terrasses" de la Vistule indiquées par M. Lencewicz ont des équivalents en France; si elles ne sont pas distinguées d'une manière générale, c'est parce que leur continuité est moindre que celle des terrasses de 15 m. environ d'altitude relative, dans les vallées de la Loire ou de la Seine.

PROF. P. FOURMARIER insiste sur l'utilité qu'il y aurait trouver un système tout à fait précis pour désigner les terrasses. Les termes de haute, moyenne, basse terrasse prêtent à confusion lorsqu'il s'agit de comparer deux régions différentes. La base paléontologique (ossements, flore, instruments) serait évidemment la plus sûre. En ce qui concerne les terrasses situées à faible hauteur au-dessus de la plaine alluviale, il existe, le long de la Meuse, en aval de Liége, sur territoire hollandais, une terrasse dont la base est à 2 ou 3 m. au-dessus du fleuve. Or la Meuse est voisine du réseau hydrographique français; ce fait confirme les observations de M. Chaput.

PLEISTOCENE TERRACES IN POLAND

PROF. S. PAWLOWSKI

Abstract (*see* NOTE, *p.* 157)

Throughout Poland, not only in the glaciated north but also in those parts of the south where glaciation has been absent or only partial, there is a striking development of what may be called the "principal" terrace at a height of 15–30 m. It is difficult to establish a parallel between the north and south, though the general development and state of preservation of this terrace point to analogous circumstances. There are, however, considerable regions along the Vistula, the middle Niemen and Dniestr where this terrace is missing or only feebly

represented. Its absence or abnormality in height may be attributed to tectonic movement, which has been traced in some places.

The writer is inclined to the belief that in Poland the formation of the highest Pleistocene terraces took place during a period of glacial recession, whereas the lower Pleistocene terraces, and especially the principal terrace, arose from hydrographic conditions answering to those now existing. It is difficult to establish a connection between the Polish and Alpine glaciations, or to find the correlation between these and the formation of the Carpathian terraces. In the Carpathians there is only one principal terrace, whereas there have been in Poland at least two glaciations. Poland, covering a region where a continental glacier from the north impinged upon a mountainous region which was itself covered here and there by ice, offers in this respect a field for research of great importance.

LE RÔLE DES SURFACES POLYGÉNIQUES DANS LE MODELÉ

PROF. J. E. CHAPUT

In the absence of an abstract[1] *the following introductory remarks will afford here some idea of the scope of the paper and definition of the terminology employed.*

Lorsqu'une surface topographique présente un aspect à peu près uniforme, un modelé peu varié, il est parfois difficile de savoir si la sculpture de cette surface s'est faite en une seule phase ou pendant plusieurs périodes successives, et d'une manière continue ou plus ou moins saccadée. Pour préciser ceci, j'appellerai *surfaces monogéniques* celles dont le modelé est partout sensiblement du même âge, et *surfaces polygéniques* celles qui sont formées, en réalité, par toute une série de surfaces élémentaires modelées successivement.

PROF. D. JOHNSON expressed his interest in the paper presented by Prof. Chaput, an interest intensified by his belief that students in geomorphology must give increasing attention to land forms developed under dynamic rather than under static conditions of the earth blocks being carved, as well as of the forces producing the carving. He had found the idea helpful in the study of shore forms developed on rising and sinking coasts, and equally so in the study of erosion forms on gradually upraised mountains of different types. Referring to Prof. Chaput's terrace terminology, he expressed the feeling that the terms *polygénique* and *monogénique* were a little confusing, since one had to remember that the *polygénique* terraces developed in a single phase of river erosion, whereas *monogénique* terraces represented multiple phases of river erosion—an apparent contradiction that was puzzling to the student. Prof. Chaput's work on the terrace problem had been so illuminating that he desired further to emphasize the point that it was not so much the difficulty of *understanding* the terminology as of *remembering* it on the part of students.

[1] *See* NOTE, *p.* 157.

M. CHAPUT insiste sur le fait qu'il a employé les termes de terrasses monogéniques et de terrasses polygéniques pour exprimer les caractères du modelé de la surface (genèse unique ou genèse multiple). On aurait pu employer d'autres mots pour exprimer l'unité d'âge ou la diversité d'âge, ainsi que l'évolution progressive. Mais il ne semble pas que jusqu'ici l'on ait proposé de termes meilleurs que ceux adoptés ici.

ORIGEN DE LAS RÍAS

PROF. RAFAEL DE BUEN

Gracias a la amabilidad del Jefe de la Junta de Obras del Puerto de Vigo, Sr Cabello, me fué posible realizar el análisis de una serie de doce muestras de fondos marinos correspondientes a un trépano realizado en la ría de Vigo desde la superficie del sedimento sumergido hasta catorce metros de profundidad en el mismo.

Los análisis, hechos según el clásico procedimiento del profesor Thoulet, mostraron la existencia de variaciones en el grosor relativo de los granos que constituían los distintos sedimentos, por lo cual pude derivar la existencia de variaciones en la profundidad del punto en que fué llevado a cabo el trépano y por lo tanto de oscilaciones de nivel concomitantes.

Sabemos, en efecto, que, en virtud del principio de Lavoisier, un depósito actual ó antiguo que se haya originado cerca de la costa nos muestra que el suelo ha sufrido una elevación si el grosor de sus granos minerales disminuye desde la parte superior hacia abajo y que, en cambio, el aumento de los granos señala un hundimiento. Las sucesivas variaciones del tamaño de los granos minerales observadas en el trépano de Vigo estarán en relación, por lo tanto, según se desprende del principio de Lavoisier, con sucesivas elevaciones y hundimientos del suelo del cual forman parte.

De comprobarse, como parece natural que así sea, la existencia de oscilaciones de nivel en las rías, los resultados obtenidos por nosotros ofrecen un gran interés geográfico, puesto que nos aclaran considerablemente cual ha sido su verdadero origen y han de permitirnos, como veremos en el transcurso de este trabajo, exponer una nueva teoría sobre la formación de las rías, fiords, skiers, glens y demás tipos de valles sumergidos existentes en el globo, de la cual nos hemos ocupado ya en trabajos anteriores[1].

[1] "Analyse de douze échantillons de fonds sous-marins provenant d'un sondage au trépan exécuté dans la ria de Vigo et considérations sur la genèse des rias.' *Bull. Inst. Ocean.* no. 474, Monaco, 25 mars 1926.

Antes de entrar de lleno en la exposición de nuestra teoría señalaremos, aunque sólo sea muy ligeramente, los caracteres de las distintas formaciones cuya unidad de origen vamos a discutir, indicando, antes, que los nombres que han recibido por los geógrafos de distintos paises parecen ser debidos, más que nada, a la tendencia muy humana de buscar el mayor número de caracteres distintivos en su estudio, puesto que la naturaleza suele tender por el contrario a la mayor uniformidad posible, coincidiendo con una gran simplicidad. Realmente, en el punto concreto que estudiamos, los tipos de valles sumergidos, que han recibido muy variados nombres, son debidos siempre a fenómenos de hundimiento costero preponderantes, aunque hayan llegado a la configuración actual por oscilaciones verticales más o menos acentuadas.

En los fiords se reconoce una acción glaciar preponderante, siendo los valles sumergidos mejor estudiados, más característicos y más numerosos. Aparecen como valles estrechos y muy ramificados ocupados por el mar, con costas abruptas y elevadas, que dan al paisaje una extraordinaria belleza.

Abundan los fiords en las regiones vecinas a los Polos ocupando en el Atlántico N. considerables extensiones del litoral escandinavo, de Groenlandia, Islandia, Terranova, Labrador, etc. y alcanzando incluso las costas de Irlanda y de Escocia. Formaciones análogas han sido también estudiadas, por ejemplo, en el Sur de Alaska, en la Tierra del Fuego y en Patagonia, que es, según Nordenskjold, la zona más rica del mundo en este tipo de valles sumergidos.

Los skiers de Suecia y Finlandia aparecen en las costas de poca elevación, que se presentan divididas, fragmentadas y entre las cuales penetran las aguas marinas constituyendo como ramificadas bahías muy abundantes en islas. Suponen los geógrafos que los skiers, a los cuales se asemejan algunas formaciones existentes en Islandia y entre las costas del Maine a los Estados Unidos, tienen un origen moderno y a causa de ello la abrasión litoral es poco aparente, reconociendo que fué debida su aparición a hundimientos costeros.

Los glens, existentes en Escocia é Irlanda, se asemejan a los fiords pero su aspecto rectilíneo hace creer que se originaron acentuadas fracturas por las cuales se verificó la invasión de las aguas.

Las rías son también valles sumergidos, pero su aspecto es esencialmente fluvial, poseen dimensiones menores que las de los fiords y su profundidad no es tan elevada. Aunque se hayan tomado como tipo y se haya adoptado su nombre en la terminología geográfica, las rías

gallegas no son únicas, existiendo análogas formaciones en las costas de Bretaña y en las de Nueva-Brunswick y Terranova.

Podríamos citar aun otros tipos de valles sumergidos pero no lo estimamos necesario teniendo en cuenta que el objeto de nuestro trabajo no es establecer diferencia entre ellos, sino por el contrario el buscar las analogías que presentan, que han de permitirnos el dar una teoría general sobre su origen.

Tratando de establecer los puntos de contacto existentes entre los fiords, skiers, glens, rías, etc., vemos en primer lugar que son todos ellos debidos a un hundimiento predominante de la costa, que ha permitido la invasión marina. Siendo originados por oscilaciones verticales del suelo, tendremos que basarnos en el estudio que vamos a emprender en la teoría isostática, ya que ella pueda darnos la clave al proporcionarnos una base sólida sobre los movimientos que el desequilibrio isostático origina para lograr la estabilización.

Siendo debidas las oscilaciones de la corteza terrestre a un desequilibrio isostático, deberán producirse, en las localidades en que su frecuencia sea grande, fracturas coincidentes con movimientos sísmicos. Este hecho se ha observado con claridad en los glens escoceses é irlandeses, y son análogamente zonas de temblores de tierra frecuentes la Península Escandinava, Escocia, Galicia y las otras localidades donde aparecen valles sumergidos.

Bajo este concepto puede ya establecerse una analogía interesante entre los glens y el relieve escandinavo, ya que en los primeros las rupturas del terreno tienen la misma dirección del N.E. al S.W. que presentan muchas de las profundas fallas que atraviesan las montañas noruegas y suecas.

La coincidencia de una sismicidad acentuada con la formación de valles sumergidos da un gran valor en la explicación de su origen al estudio de los temblores de tierra, haciendo que sea la sismología la ciencia que puede darnos datos de mayor interés sobre el equilibrio de los bloques terrestres.

En el caso de las rías de Galicia, que nos interesa especialmente, comprobamos que según los trabajos de Alfonso Rey Pastor y Vicente Inglada, que han estudiado las zonas sísmicas españolas, se separa de la región central el macizo de Galicia y el Duero, en el cual las condiciones son distintas y hacen que la costa gallega experimente una inmersión hacia el oeste.

En Galicia no son los temblores de tierra desastrosos, sino que por el contrario las sacudidas tienen en general poca intensidad y rara vez violencia acentuada. Como tipo de sismo de esta región podemos citar

él de 26 de Noviembre de 1920 que sólo provocó la caída de muebles y ocasionó algunos desperfectos en edificios poco sólidos. El estudio de este sismo permitió a la Estación sismológica de Toledo el establecer que su foco fué submarino y estuvo situado a unos setenta y cinco kilómetros al oeste de Oporto.

En el caso de los fiords puede atribuirse el desequilibrio isostático que ha ocasionado el hundimiento a la acción variable ejercida por los hielos, dada la proximidad de estas formaciones al Polo y la mayor intensidad alcanzada por el glaciarismo en ciertos momentos de la vida terrestre.

Parece natural, en efecto, suponer que si sobre un bloque isostático se acumulan los hielos en cantidad suficiente logran aumentar su peso y provocar su hundimiento en el magma de *sima* sobre el que reposan, hasta conseguir que sobrevenga el equilibrio.

El estudio de las costas y de las isobatas próximas a ellas ha permitido a de Geer el suponer que la Península Escandinava, por efecto de las enormes masas de hielo que la recubrieron en épocas anteriores, llegó a estar a un nivel inferior en doscientos cincuenta metros al que tiene actualmente. Según esto, la desaparición de los hielos deberá originar una lenta ascensión de las tierras que parece alcanza actualmente próximamente un metro por siglo. Un fenómeno análogo tuvo lugar en el Canadá donde el hundimiento debió alcanzar próximamente unos quinientos metros.

Para poder explicarse un descenso de las tierras de amplitud tan considerable ha tenido que admitir Rudzki que los hielos que cubrieron el extremo septentrional de América del Norte alcanzaron el enorme espesor de mil seiscientos setenta metros y de novecientos cincuenta metros en la Península Escandinava. Estas evaluaciones han de parecernos seguramente excesivas dada la idea que de la glaciación tenemos en la actualidad y aunque supusiéramos su posible existencia sólo habría que admitirla en las regiones poco distantes del Polo, lo cual nos daría la clave de la frecuencia de valles sumergidos (fiords y formaciones análogas) en latitudes elevadas.

En el origen de las rías no aparecen vestigios de una influencia glaciar aparente, siendo precisamente este carácter el que ha servido para distinguirlas y ha hecho pensar en un origen completamente diferente. Ya veremos nosotros en el transcurso de este trabajo que, aun no admitiendo para nada una acción de los hielos, podemos sin embargo hallar tantos puntos de analogía con los demás valles hundidos y ocupados por el mar, que nos permite dar a todas estas formaciones, cualquiera que sea su aspecto, una gran identidad de origen.

Modernamente algunos autores han expuesto que realmente los fiords no han sido originados por los hielos sino que se trata de zonas de fractura que posteriormente fueron invadidas por glaciares. Esta opinión defendida por Gregory ha sido apoyada muy recientemente por Wegener. En el caso de que se compruebe que los fiords son valles de fractura, se puede establecer una gran analogía entre ellos y los glens, y si también las rías tuvieran análogo origen se unificaría extraordinariamente la relación existente entre todos los valles sumergidos.

En el caso de las rías, su orientación uniforme y las zonas limitadas en que se extienden, al par que el hallarse rodeadas de terrenos en los cuales no son tan visibles los fenómenos de hundimiento, podrían explicarse por estar originadas por fracturas próximas a la costa, ya que de otra manera es difícil llegar a comprender los caracteres que presentan.

Lo mismo pasa con los fiords, puesto que suponiendo una acción glaciar única resultaría inexplicable su gran profundidad y la pendiente excesivamente brusca de sus orillas. Parece más natural suponer que los hielos hallaron franco su camino por la existencia de fallas previamente producidas por hundimiento de los bloques isostáticos, que según nos dice Wegener descansan en el Atlántico sobre un sima de una fluidez mayor que la normal.

Suponiendo que todos los valles sumergidos han sido originados por fracturas de los terrenos que los constituyen y que ha existido posteriormente, ó al mismo tiempo, un descenso de las costas, que ha permitido la penetración del mar, tendremos que buscar, únicamente, para establecer la unidad de estas formaciones, cuales han sido las causas probables capaces de originar el desequilibrio isostático, productor del descenso de los bloques.

En el caso de los fiords de latitudes elevadas, ya hemos indicado que los geógrafos se muestran de acuerdo en que la acción glaciar ha sido preponderante, debiendo haber dado lugar el aumento de peso de los bloques, por la masa de hielos que tuvieron que soportar, a su penetración en el sima y por tanto a su hundimiento.

Pero no se trata normalmente en los valles sumergidos de un fenómeno simple de hundimiento sino que, como ha sido demostrado para los fiords y parecen señalar para las rías los resultados del análisis del trépano de la de Vigo, que hemos realizado, existen verdaderos movimientos basculares, alternando los períodos de descenso del terreno con otros en que existe una ascensión. Este carácter oscilatorio debe ser uniforme en todos los valles sumergidos y en lugar de complicar el problema de su origen ha de permitirnos el poder establecer aun mayores analogías.

En el caso de los fiords es fácil encontrar la causa de los sucesivos hundimientos y elevaciones del terreno, ya que si suponemos que han sido los hielos los que más influencia han ejercido tenemos que admitir que, variando en las distintas épocas la masa glaciar soportada por los bloques isostáticos, estos habrán tenido forzosamente que sumergirse más en el sima en los momentos de mayor acción glaciar y elevarse sobre él en los instantes en que esta acción fuera menos intensa.

Antes de estudiar con detalle las analogías existentes entre todos los valles sumergidos habíamos llegado a la creencia de su origen único porque contemplando en un mapa geológico su distribución en el Atlántico Norte, y aun en otras regiones de la tierra, nos llamó poderosamente la atención un hecho que tal vez haya pasado desapercibido a la mayoría de los geógrafos y que ha de servirnos para el desarrollo de nuestras nuevas teorías. Me refiero a que tanto los fiords, como los glens, skiers, rías, etc., coinciden de manera casi absoluta con los afloramientos de terrenos primitivos.

Sabemos, en efecto, que por las costas de América del Norte se extiende un arco de formaciones arcaicas cuyo extremo sur está ocupado por los macizos de la Bahía de Fundy, de Nueva Brunswick, de la Isla de Cabo Breton y de Terranova, en cuyas localidades los valles hundidos son tan abundantes que han sido designados por Suess con el nombre de costas de rías, a causa de la analogía que presentan con las rías europeas. Existen por tanto en la parte más meridional de América rías como las gallegas ó las bretonas, faltando por completo en el norte, donde lo mismo en el antiguo que en el nuevo continente dominan los fiords; este hecho curioso nos hace pensar en que el paso de una formación a otra es sólo una cuestión de latitud, y que por lo tanto no son otra cosa las rías que fiords más meridionales con aspecto algo diferente a causa de que el influjo glaciar, muy aparente en el norte, es poco perceptible ó nulo al acercarnos al ecuador.

Siguiendo con el estudio que hemos emprendido, de la naturaleza geológica de los terrenos vecinos al mar, podemos señalar que en las costas del Canadá, yendo hacia el norte, las rocas de la cadena costera del Labrador, estudiada por Robert Bell, pertenecen al grupo de los gneiss y otros terrenos antiguos, estando en su parte baja redondeadas por la acción de los hielos mientras las cimas, muy agudas, nos señalan que sobre ellas la influencia glaciar ha sido muy poco acentuada.

La naturaleza arcaica de las tierras de Baffin y de las costas occidentales del Estrecho de Davis ha sido demostrada por Sutherland,

y el Dr Boas ha mostrado que la zona comprendida entre la Península de Cumberland y el Estrecho de Lancaster está ocupada por una montaña antigua. En todas estas localidades las costas se caracterizan por la existencia de profundos valles ocupados por el mar que, por su poca anchura y sus margenes verticales, se asemejan considerablemente a los fiords de Noruega.

Para terminar con la región americana señalaremos que los trabajos geológicos de MacClintock han puesto de manifiesto que las islas y penínsulas que se extienden entre el continente americano y el norte del archipiélago Parry, donde tan abundantes son los valles ocupados por el mar, constituyen el extremo norte de los terrenos arcaicos que se continúan por el Labrador y la tierra de Baffin.

Pasando a Europa vemos que las formaciones geológicas antiguas, estudiadas en América, tienen su representación en sus costas: la Laponia y la Finlandia están formadas por rocas primitivas, y según la autorizada opinión de Suess el Báltico representa la inmersión parcial de una plataforma primitiva denudada, análoga a la de la Bahía de Hudson. Terrenos arcaicos semejantes aparecen en las costas del Mar Blanco y de la Península Escandinava, regiones que, como es bien sabido, están invadidas por valles de hundimiento, en los que se ha comprobado la existencia de oscilaciones de nivel.

En las regiones europeas más meridionales observamos que los afloramientos antiguos existen en las Islas Británicas, siendo la opinión de Judd y de A. Geikie que los Highlands de Escocia, las Hébridas y el Donegal, las Horcadas y las Shetland son fragmentos de la Península Escandinava. La uniformidad de su estructura y la concordancia tectónica indican que las costas atlánticas comprendidas entre el Cabo Norte y la Bahía de Donegal, en Irlanda, é incluso más al sur, constituyen una cadena de estructura idéntica, que debió formar una masa única en épocas geológicas anteriores.

Bonney ha llevado más adelante esta igualdad de los terrenos primitivos europeos al suponer que los que existen en el norte de Francia son la prolongación de los de Inglaterra, Escocia é Irlanda, con los cuales presentan un gran número de caracteres comunes. No queda por lo tanto entre las costas en que abundan los valles sumergidos más localidad aislada que nuestras costas gallegas, en las cuales tal vez un estudio detallado permita establecer relaciones directas con las rocas arcaicas de Francia, de las Islas Británicas y de la Península Escandinava.

En el Atlántico Norte los terrenos arcaicos se extienden por Spitzberg y Groenlandia, donde las exploraciones de Payer, de Copeland

y de otros muchos, así como los estudios de Hochstetter y sus continuadores, han mostrado que la costa está casi toda ocupada por terrenos primitivos dominando, por ejemplo, en la costa W. de Groenlandia, entre el Cabo Farewell y los 61° de latitud norte, y aun hasta más lejos de los 72° 30′, los granitos y los gneiss.

Las consideraciones anteriores nos hacen ver la utilidad de que sea un hecho un estudio comparativo de los terrenos arcaicos del Canadá, Groenlandia, Spitzberg y demas tierras de América del Norte, por una parte, y del área primitiva europea por otra. Como hemos visto, en el antiguo continente existe una gran analogía entre estas formaciones, y si se comprueba que las del Norte y de América poseen caracteres semejantes, y al propio tiempo con los de Europa, se encontrará una confirmación de la teoría expuesta por Wegener sobre deriva de los continentes, ya que resultaría natural suponer que los terrenos arcaicos de todo el Atlántico Norte, que están actualmente separados, debieron constituir, en épocas geológicas anteriores, un bloque único fragmentado al separarse los continentes en el transcurso del tiempo.

Expuestos los anteriores razonamientos podemos llegar a una conclusión de enorme interés: Que *todas las costas del Atlántico Norte, formadas por terrenos primitivos, se caracterizan por la existencia de fenómenos de hundimiento que han dado lugar a la presencia de valles de fractura sumergidos.* Cuando en la naturaleza aparece un hecho con un carácter de generalidad tan acentuado es necesario suponer que existe una causa principal única productora de los fenómenos observados.

Segun Wegener, y otros muchos autores, los bloques continentales están constituidos por rocas primitivas, principalmente gneiss, que desde la parte inferior de los terrenos sedimentarios se extienden hasta el sima que les sirve de base. Seguramente podremos hallar la explicación de los movimientos de equilibrio isostático en la manera como accionara la masa uniforme y extensa de los gneiss y otras rocas primitivas que forman casi todo el bloque.

El espesor de los terrenos sedimentarios depositados sobre los bloques antiguos es relativamente pequeño: por ejemplo los geólogos americanos han calculado para los Apalaches espesores de unos 10 km., como máximo, y Clark da la cifra de 2400 m. como valor medio.

Teniendo en cuenta que los terrenos sedimentarios están desigualmente distribuídos, su espesor varía considerablemente, pudiendo ser nulo en ciertos casos, y aflorando entonces las rocas primitivas en la corteza, y alcanzando en otros una potencia muy variable. El bloque

antiguo soporta de esta manera un peso desigual de terrenos sedimentarios en distintas localidades, siendo ello una causa importante de desequilibrio.

Si los terrenos sedimentarios no se modificaran, los bloques sobre los cuales descansan permanecerían inmóviles, pero en la naturaleza todo está sujeto a cambio y la erosión continental y abrasión costera destruyen la corteza terrestre, siendo arrastrados por el agua ó los vientos los elementos disgregados del suelo, para depositarse en lugares a veces muy distantes. El transporte de elementos minerales de una localidad a otra hace que la carga que soporta un bloque isostático disminuya para aumentar la del vecino ó simplemente que cambie de posición sobre el mismo bloque; en ambos casos sobrevendrá el desequilibrio y se originarán oscilaciones. A esta causa deben unirse también los plegamientos que se forman en la corteza terrestre y que acumulan masas, a veces enormes, de elementos que ocupaban considerable extensión en zonas mucho más limitadas.

Como las rocas primitivas son la base de los terrenos sedimentarios y forman normalmente una masa casi única, hay que suponer que en ellos se manifestarán con gran claridad los movimientos de equilibrio que pueden hacerse perceptibles por los fenómenos de hundimiento ó elevación a que dan lugar, y que han de ser más facilmente destacables en aquellos puntos en que se tiene un nivel de comparación, como pasa en las costas. Las experiencias de Nagasko y Kusakabe han puesto de manifiesto que los terrenos antiguos son los que mayor elasticidad presentan, tal vez debido a aparecer compactos y a su densidad elevada; también sabemos que por ellos se transmiten mejor las sacudidas sísmicas.

En los fenómenos de hundimiento ó elevación de los bloques hay que tener también en cuenta la existencia de enormes masas de hielos, cuya aparición ó desaparición será causa de un marcado desequilibrio. Esto nos explica el que los bloques próximos al Polo estén sujetos a cambios más frecuentes de carga, y que los movimientos verticales, que allí dan lugar a la formación de fiords, sean más aparentes y acentuados.

En armonía con la consideración anterior sabemos que las oscilaciones, predominantemente descendentes, son más frecuentes en latitudes elevadas, y, según dice E. Robert en una nota que presentó a la Academia de Ciencias de Paris, las variaciones de nivel en las costas antiguas son tanto más frecuentes cuanto mayor es su proximidad a los Polos. Adhemar señala también la influencia que sobre estas modificaciones del nivel ejercen los cambios sufridos por los hielos

polares, atribuibles a las posiciones que ocupa la tierra con respecto al Sol, que hacen variar su acumulación en uno ú otro polo; este desplazamiento da lugar a una inmersión del hemisferio que corresponda al polo que posee el máximo de carga. También habrá que tener en cuenta que los polos no tienen una posición constante, y que sus desplazamientos deben influir en la repartición de los hielos que los rodean.

Debemos finalmente hacer intervenir en estas cuestiones, de equilibrio isostático costero, a la acción de algunos factores marinos. Sabemos, por ejemplo, que ha llamado la atención de los geógrafos el que los valles sumergidos se encuentren siempre en localidades de mareas intensas, haciendo suponer que, si bien la acción de estas no puede influir en su origen, sí lograrán las corrientes que se producen contribuir a que no se recubran excesivamente de sedimentos. La acción de las mareas no será solamente una acción mecánica, sino que forzosamente tendrá que influir en la carga soportada por los bloques isostáticos, a la cual son debidas las oscilaciones que estudiamos.

La rápida sucesión de pleamares y bajamares no permitirá tal vez la producción de movimientos importantes, aunque el descubrimiento de movimientos periódicos del suelo, de verdaderas mareas terrestres, nos haga pensar en que su influjo es mayor de la que pudiera suponerse; pero sí influirán las variaciones de amplitud que experimentan las mareas en las diversas épocas del año y las que pueden sufrir en el transcurso del tiempo.

Creemos haber expuesto con suficiente detalle nuestra teoría sobre el origen de los valles sumergidos, quedando en virtud de ella explicado el mecanismo que ha dado lugar a fenómenos que hasta ahora no habían sido suficientemente aclarados y apareciendo la gran uniformidad de las causas productoras.

La confirmación de las ideas que hemos expuesto habrá que buscarla principalmente en la relación que existe entre los movimientos sísmicos y los cambios de nivel costero. Harboe ha realizado en la Península Escandinava esta labor y ha podido señalar la correspondencia estrecha existente entre las zonas de fractura, las variaciones de nivel y los movimientos de desequilibrio. Al estudiar los centros de inestabilidad y su importancia relativa ha logrado también Harboe trazar las lineas medias de movilidad sísmica, comprobando que coinciden con las lineas de cambio de nivel que las costas han experimentado.

PROF. G. STEFANINI: Je tiens à faire remarquer que de beaux exemples de vallées submergées peuvent être observés dans des régions formées de terrains

qui ne sont pas du tout anciens. Je citerai les vallées submergées de la mer de Ligurie, illustrées par M. Issel, et celles de l'Adriatique, mises en relief par M. de Marchi.

VŒU PRÉSENTÉ PAR LE PROF. P. FOURMARIER: La Section de Géographie physique du Congrès International de Géographie, après avoir pris connaissance du rapport de la Commission des terrasses pliocènes et pléistocènes et avoir entendu les nombreuses communications sur ce sujet, émet le vœu:

(1) Que des félicitations soient adressées à la Commission des terrasses pliocènes et pléistocènes pour son œuvre, avec l'espoir qu'elle sera sollicitée de la continuer jusqu'au prochain Congrès, en élargissant si possible son champ d'investigation.

(2) Qu'il soit demandé à l'Union Géographique Internationale d'adjoindre à la Commission de nouveaux membres de façon que tous les pays intéressés aient au moins un représentant dans son sein.

(3) Que les règles de travail soient précisées dans une publication de la Commission sur les points suivants:

(*a*) Le niveau de référence des altitudes relatives: niveau moyen des cartes marines, haute mer ou basse mer, pour les terrasses marines; niveau moyen, hautes eaux, étiage pour les terrasses fluviales.

(*b*) La définition exacte du type des formations envisagées: plages inondées, cordons littoraux, terrasses proprement dites, marines ou fluviales, terrasses locales des cours d'eau, etc.

PROF. E. HERNÁNDEZ-PACHECO, the President of the Commission on Pliocene and Pleistocene Terraces, in reply to the Resolution of M. Fourmarier, believed that he was expressing the opinion of the members of the above-named Commission in saying that:

Regarding the first point, the Commission wishes to express its most grateful thanks to M. Fourmarier.

With reference to the second point, the President is of the opinion that the nomination of new delegates should be the exclusive privilege of the Executive Committee of the International Geographical Union.

Regarding the third point, the Commission on Terraces is at present at work to establish the principal terms and methods for the study of marine and fluvial terraces of the Pliocene and Pleistocene ages.

LA SPELEOLOGIA IN ITALIA

CONTE CESARE CALCIATI

Le condizioni geologiche di non poche regioni d' Italia hanno offerto uno degli ambienti più adatti allo sviluppo del ben noto e complesso *fenomeno carsico*, denominazione tratta appunto dal Carso triestino. Ed è per incarico del "Comitato Speleologico Lombardo" ch' io mi propongo di rammentare qui, per sommi capi, l' opera che gli Italiani hanno svolta per il passato anche in questo campo, e quella sopratutto che svolgono oggi con rinnovata attività.

Fin dal 1726 il Vallionieri, in seguito ad osservazioni personali fatte in cavità delle Alpi Apuane, in una sua lezione accademica intorno all' origine delle fontane così scrisse a p. 65: "Osservavo attonito e poco

men che tremante, all' intorno varii giuochi come d' acque cristallizzati, rotti molti dei quali, vidi nel loro mezzo un buco passante dall' un canto all' altro fasciato all' intorno da varie lamine accartocciate, o a guisa di cipolla, o d' una pianta che, col quagliamento e accostamento del nutritivo sugo, ogni anno ingrassi."

Ecco quindi fin dal 1726 la precisa visione (espressa forse per la prima volta) dell' ormai noto processo di accrescimento stalactitico! Nel 1785 l' Abate Amoretti e Don Alessandro Volta visitano, con occhi di scienziato, alcune grotte del milanese. Dipoi, curiosità e leggende si destano intorno ai misteriosi recessi della terra di cui ancor non si spiegano i modi di formazione almeno per le cavità più strane.

La guida Luca Cec scopre nel 1818 le grotte di Postumia, alla fantastica bellezza delle quali unita alla relativa facilità d' accesso, si deve certamente in massima parte lo sviluppo degli studi speleologici della Venezia Giulia.

Infatti, non solo da tale epoca van facendosi assai numerosi i nomi dei benemeriti speleologhi italiani e stranieri; ma nel 1883 si costituisce la "Società Alpina delle Giulie" in Trieste, la quale da allora in poi, si può dire non abbia mai cessato di svolgere una fruttuosissima opera di esplorazione speleologica battendo un ritmo ognor crescente.

Quasi contemporaneamente sorge il "Circolo Speleologico-Idrologico Friulano" che compirà un lavoro notevolissimo come mole e serietà d' intenti.

Altre attività affini si manifestano in quasi tutte le regioni calcaree d' Italia, ma un nuovo e grande balzo in avanti, uno vero assalto alle grotte naturali d' ogni genere, fu ripreso dopo la grande guerra per opera sopratutto del compianto Bertarelli, President del T.C.I., mediante una serie di articoli descrittivi che vanno dal 1921 al 1926.

Poi, ancora per volontà sua, vede la luce il bel volume "Duemila Grotte," compendio e divulgazione di 40 anni di ricerche nella Venezia Giulia, ed è in tal modo che fra tutti i turisti italiani si rivela, si insinua, si impone un certo interesse intorno ai misteri delle cavità terrestri con tutte le loro decantate bellezze artistiche e curiosità biologiche; di modo che uno dei primi ed importantissimi frutti di tale propaganda si ha oggi nella costituzione dei nuovi "Gruppi grotte" (sorti spessissimo in seno alle Sezioni del C.A.T.) quali quelli di Brescia, di Bergamo, di Cremona, di Firenze, di Milano, di Verona, ed altri.

Tutti questi "Gruppi," di giovani volonterosi, ciascuno per la propria regione, appoggiati anche dalle Autorità militari, ma sopratutto con sacrifici ed ardimenti personali, collaborano alla compilazione del già iniziato catasto delle grotte d' Italia.

Cosicche, dalle poche centinaia che ci erano note alcuni anni or sono, le cavità esplorate sommano già a più di 4200, e non va dimenticato che fra esse si annoverano gli abissi più profondi della terra:

Abisso di Clana presso Fiume con ... ... 420 m.
„ di Bertarelli in Istria con ... ... 450 m.
„ di Mantenero presso Istria con ... 480 m.;

finalmente l' Abisso della Preta nel Veronese, il più profondo di tutti, 657 m.

Quanto prima sarà fondato un "Istituto Italiano di Speleologia" che dovrà dirigere, raccogliere ed utilizzare il lavoro sparso dei singoli, intorno ad un fenomeno che costituisce un interessante e particolare primato di terra italiana. Ma allora io son certo che dalla prima fase preponderantemente esplorativa, ossia estensiva, la Speleologia italiana si avvierà sempre più verso lo studio scientifico di tutti i complessi problemi ai quali sbocca la circolazione idrica del sottosuolo calcareo. Ed allora più che mai, il patrimonio speleologico italiano sarà méta ancor più frequentata e palestra insuperabile per tutti gli stranieri che si interessano a questa giovane e promettente branca della geografia fisica.

21 July (with Section E)

VARIATIONS OF CLIMATE IN THE PAST

PROF. J. W. GREGORY

1. *Three Rival Opinions regarding Climate in Historic Times*

The fickleness of the weather is proverbial, and in view of its marked variations from year to year it is natural to expect that in the past there have been still greater differences and that they explain many important geographical processes and historical events. Geological evolution has been represented as powerfully influenced by climatic changes. There have been three main trends of opinion in regard to variation of climate. According to some authorities extreme changes have happened owing to such causes as an increase or decrease of heat received from the sun, or the sliding of the earth's crust around the interior, so that the poles have moved to the tropics, carrying Arctic conditions to the Equator and tropical to Greenland. Other authorities consider that the variations, although due to astronomical agencies, were less severe, but were sufficient to ruin once fertile territories, to wither their crops, and to enforce the national migrations that have revolutionized human history. A third view is that of the general

constancy of the earth's climate as a whole, the local changes being regarded as comparable to the differences that exist to-day between places on the same latitude, such as between the climates of Ireland and Labrador, of Norway and South Greenland, and between deserts and forest jungle that lie on the same parallel. Great climatic differences co-exist in the same latitudes to-day owing to local geographical circumstances; hence the replacement of a cold by a warm climate or of desert by dense forest does not require great astronomical or physical changes, as they may follow from a different distribution of land and water.

2. *The Constancy of Climate during Historic Times*

The advocates of great climatic changes and their control over human development hold that a progressive change is still taking place. They attribute to variations in climate the failure of crops that were once grown in north-western Europe, such as the abandonment of vine cultivation in England; the decrease in rainfall in some countries, as in Palestine, whereby the Dead Sea has shrunk from a great fresh-water lake to a small salt sea; they say the desiccation of Central Asia forced the inhabitants to invade Europe, and the collapse of the ancient civilization of Greece was due to the spread of malaria when perennial rivers dwindled during the dry season into stagnant mosquito-haunted pools.

There has, however, been no considerable change of climate in historic times in any country of which there is adequate evidence. Thus in Palestine about 1000 B.C. the temperature must have been essentially the same as at present; it was not warmer, for though palms grew foliage on the highlands of Judaea, they produced fruit only at Engedi on the shore of the Dead Sea; and it was not colder, for Palestine was then as now on the southern edge of vine cultivation. Dr Hume, among other authorities, reports that in Egypt the climate has shown no signs of change for 14,000 years. As regards Greece, Dr Eginitis of the Athens Observatory concludes that the mean annual temperature has not changed 1° C. since classical times. In Cyrenaica the range of the vegetation is to-day as it was when described by Strabo, and the Roman waterworks show that the rainfall was sparse, elaborate care being taken to cherish the scanty supply. In Algeria during Roman times the salt pools, the shotts, were of their present size. In south-western Asia the difficulties of Alexander the Great's retreat from India indicate that the conditions then were the same as they are now. The early records from India picture

conditions of life that were, so far as depended on climate, those that prevail to-day; and as regards Central Asia, for which assertions of modern desiccation are the most constant, the archaeological evidence indicates that the existing geographical conditions have held throughout the historic period[1].

In recent years the climatic changes claimed as having taken place in historic times have become comparatively slight; Prof. Ellsworth Huntington attributes great effects to a very slight temperature variation. The most authoritative recent claim for a considerable modern climatic change is that of C. E. P. Brooks[2], who accepts the view that in the tenth and eleventh centuries south-eastern Greenland[3] was occupied by a pastoral Norse colony with herds of cattle and thriving crops, and an ice-free sea; he holds that the climate became more severe, the ground permanently frozen, and that the colonists were exterminated by the increasing cold. On asking Mr Wordie for his opinion on the evidence from the sagas, he tells me that "they make it clear that in the tenth and eleventh centuries there was an ice-current down the East Coast, which hindered even small boat navigation[4]."

The evidence for a climatic change in southern Greenland, based on the fate of the Norse colonies, is most uncertain. Dr Poul Nörlund[5], from a careful study of the skeletons of the Norse settlers, attributes their extinction to deterioration in physique owing to the severe environment and bad food.

Daniel Bruun's *Icelandic Colonization of Greenland* assumes that the country in the tenth and eleventh centuries had its present climate[6]; one of Eric the Red's place-names was the Middle Glacier; and according to Bruun he was unable to land on the south-eastern

[1] *Geogr. Journ.* 43 (1914), pp. 148–72, 293–313.

[2] C. E. P. Brooks, *Climate through the Ages*, 1926, pp. 164, 397–8.

[3] The eastern colony was on the western coast of Greenland. The eastern coast was inaccessible and uninhabitable.

[4] Mr Wordie adds in a later letter: "I feel that there has been some change of climate on the West Coast, but doubt very much if it was of great moment. I am certain that there has always been ice on the East Coast since Eric the Red's time, varying in amount but always there. There is no ground to suppose a big setting-in of ice on either the East or the West Coasts from about 1200." Eric the Red's first visit to Greenland was in the year 985 or 986. Prof. W. Werenskiold, who is intimately acquainted with the Norse colonization of Greenland, also rejects Mr Brooks' conclusions.

[5] "Buried Norsemen at Herjolfsnes," *Medd. om Grönland*, 67 (1924), pp. 230, 232, 235, 242, 243, 252–3. He states (p. 230) that the people lived on cattle, sheep and hunting, and that some farmers tried "to grow corn for the sake of experiment."

[6] *Medd. om Grönland*, 57 (1918), pp. 22–4.

coast because of the ice; some of the sagas, such as that of Thorgils Orrabeinsfostri[1] of 1001–1003, indicates that the sea was as ice-littered as it is in a normal season now. The thirteenth-century saga, the "King's Mirror[2]," describes the seas as covered by ice 4–5 ells thick, and four to five days' journey in width, and says that there was "such a profusion of ice in the water as one never sees in any other part of the world."

The hypothesis that the climate of eastern Greenland was mild and the sea ice-free in the tenth and eleventh centuries, and that it had become more severe by the thirteenth to fourteenth centuries, rests on a most uncertain basis; but the evidence for some increase in the extent of the ice in parts of Greenland led me[3] in 1913 to mark it as one of the countries with an increased precipitation; but the fuller information now available has weakened the evidence for the conclusion then adopted that in the days of the Norse colonies "part of eastern Greenland was far less ice-bound than it is to-day."

Brooks lays stress on the route to the south having gone for some distance north up Davis Strait before crossing it as evidence that the sea there was ice-free; whereas, according to Bruun[4] that route may have been followed to avoid the crowded ice at the mouth of Davis Strait. The Norse settlements in south-western Greenland may have suffered from a local advance of the ice-sheet. That it is now more extensive than formerly has often been asserted; an advance on the southern edge might result from a local increase in snowfall due to a slight difference in the wind; it would not imply any change in the climate of Greenland as a whole.

3. *Climatic Changes in pre-Historic Times (Early Pleistocene)*

Though the evidence is in favour of the general uniformity of climate throughout the historic period, in pre-historic times there were great variations. In the time of Palaeolithic man the existence of ice-sheets in Scotland, northern England, Wales, Scandinavia, Canada and the northern United States, and the extension of glaciers in the chief mountain chains are evidence of an important climatic change in many parts of the world. On the recovery from glaciation the climate was for a time unstable, and there were alternations of warmer and colder periods. Thus in the Neolithic the climate was

[1] *Medd. om Grönland,* 57 (1918), pp. 74, 76.
[2] *Ibid.* pp. 25 and 34.
[3] *G.J.* 43 (1914), pp. 303–4 and map, p. 319.
[4] *Medd. om Grönland,* 57 (1918), pp. 58, 60.

probably more genial than it is to-day. The Great Ice Age improved the climate of some countries, for it gave the Mediterranean region and northern Africa, as far south as Abyssinia and Kenya Colony, an ampler rainfall; but these conditions were long pre-historic, and the contemporary occupation of the Jordan Valley by a vast fresh-water lake has been estimated from the salinity of the Dead Sea as not less than 50,000 years ago.

4. *General Constancy of Climate in the Past*

In spite of such marked changes of climate as that of the Glacial Period, the climate of the earth as a whole has varied throughout geological time within much the same range as that experienced on the earth to-day. There have been great local variations such as displacements and extensions of areas of glaciation; but the average climate of the earth since the beginning of the Palaeozoic era has apparently never been appreciably different. Physical geology supplies no convincing evidence of any period when the atmospheric conditions were fundamentally different for the earth as a whole from those at present. For example, in the very oldest unaltered sedimentary rocks, such as the Torridon Sandstone of the British Isles, the equivalent Keewenawan of North America and the Waterberg Sandstone of southern Africa, the size of the sand grains shows that the wind was of the same force in that primeval period as it is now. The pebbles in ancient and modern beach conglomerates are of the same general size, whereas if there had been periods in which the climate had been markedly different the wave action should at times have been far more powerful. Ripple marks also bear testimony to the uniformity of wind strength, as do sun cracks and ancient soils to terrestrial heat.

5. *The Nature of Proved Variations explicable by Geographical Factors*

Though the climate of the earth as a whole has not been either materially colder or hotter throughout the time represented by fossiliferous rocks, certain variations must have occurred. They may be grouped into two kinds—variations due to a more even condition of the land that may have affected the distribution of temperature over wide areas; and more intense local changes.

The earth's crust has sometimes remained free from violent disturbances for long periods of time, and during these denudation would lower the mountains, fill in the hollows, and widen the plains. When

the earth's relief is thus reduced the mountains would chill the air less, the winds would have a freer circulation, and temperature would be more evenly distributed. This tendency would, however, have been counteracted in two ways. First, isostasy would have maintained some mountains, and have prevented the complete levelling of the surface; but it need not have prevented the fold mountains rising into higher narrower ridges, and thus having had a more chilling effect at some times than at others. Secondly, the effects of the mountains on atmospheric circulation is insignificant compared with that of the primary agencies to which it is due.

The second grade of climatic variations, including intense local changes, is more clearly established by the geological evidence. It includes the effects of different distribution of land and water, and of widespread changes in the relief of the land masses.

The effect of such changes may be illustrated by the conclusion of Lord Kelvin that if Greenland were reduced to a low-lying country, and the submerged ridge through Iceland and the Faeroes to Scotland were lowered so as to enlarge the connection between the Atlantic and the Arctic Oceans, the latter ocean would be free of ice, and a low island at the North Pole would have no permanent snow but would be clad with vegetation.

A contrary effect would follow if the Iceland-Faeroes ridge were upraised so as to exclude the Atlantic water from the Arctic Ocean, and if the uplift of the land to the north-west of the British Isles elevated and enlarged Iceland; for this land would direct the prevalent wind from its northern side against the British Isles, and these cold currents would meet moist air from the North Atlantic, which being separated from the Arctic Ocean would have been warmer and have yielded a higher evaporation. These conditions would give the British Isles and Scandinavia a heavier precipitation. A glaciation of both countries would follow this change in the nature and distribution of the land to the north-west of Europe.

At the same time the wind systems that now traverse northern Europe would be forced to a more southern track, and give the Mediterranean countries, including North Africa and Palestine, a more generous rainfall.

The climatic conditions of Europe in the Glacial Period may be explained without any fundamental change in the heat supply from the sun, in the nature of the atmosphere, or in the position of the poles. They may be accounted for by vertical oscillations in the crust and in areas where such changes are highly probable.

6. *Claim for Former fundamentally different Climates*

The proved geological climatic changes seem all explicable on similar lines, if allowance be made for the differences due to the development of vegetation. The excess of desert conditions in early geological time was the natural result of the absence of turf; the wind played on far larger areas of sand and loose earth than it has done since the development in the Devonian of a turf-like vegetation. A uniform climate and temperature over the whole earth has been frequently claimed from the evidence of fossil plants. This view has been especially advanced upon the evidence of the floras of the Coal Measures and of the Jurassic. But instead of the whole earth having had in Carboniferous times a moist hot climate, as claimed by Sir John Murray, deserts were then extensive and the Upper Carboniferous included at least part of the best established of pre-Pleistocene glaciations.

The widespread range of members of the Lower Jurassic flora is adequately explained by the absence of competitors, so that they spread rapidly over the sparsely occupied soils.

Marine fossils also give no evidence of any period at which the temperature of the sea, either in degrees or distribution, was fundamentally different from the conditions of the present time. The distribution of the reef-building corals indicates the uniformity of conditions from early times, and the distribution of the sea temperatures on the present plan, viz. an equatorial zone inhabited by reef corals which at times ranged north into the warm temperate zones, while the colder seas around the poles contained only single corals or small nodules formed by compound corals.

The corals support much other evidence that, through all parts of geological time for which there is adequate evidence, climatic zones were well developed and were arranged approximately parallel to the Equator. Thus we find time after time abundant coral reefs in the tropical and warm temperate zones; and they disappear when the formations are followed to the north. Thus in the Silurian period coral reefs occurred as far north as Wenlock Edge in the English Midlands; but there were none in Scotland, Greenland, or Spitsbergen, where the corals grew as isolated nodules, and not as reefs. This chilling of the northern seas is also indicated in the Carboniferous, when coral reefs were less developed in the north than in the south of England, and though they occur occasionally in southern Scotland, they are sparse and rare. Still later, in the Jurassic, coral reefs were

abundant in the Mediterranean area and in France; they are well developed in England as far north as Wiltshire, but they are absent from Yorkshire and Scotland. The British Cretaceous also shows a chilling to the north; for the Lower Greensand fauna of the south of England, with its nodular corals and varied molluscs, implies a cooler sea than those of the Mediterranean, but a warmer sea than that of the Speeton Clay, which obviously shared the conditions of the boreal Lower Cretaceous sea of North Russia.

Neumayr, in a classical memoir, claimed the existence in the Jurassic of four zones of climate—a cool temperate in the southern hemisphere, a tropical and warm temperate zone around the Equator, a cool north temperate, and a boreal; and a fuller knowledge of Jurassic palaeontology has supported this conclusion.

The claim for fundamentally different climatic arrangements has also been based on the existence of tropical floras in the Arctic regions, as in Greenland during the Cretaceous, and in Spitsbergen during the Lower Kainozoic. But the arguments based on the flora may be dismissed as invalid in view of the warning by Prof. Seward at the British Association meeting in 1926 that fossil plants give no reliable evidence of a tropical or sub-tropical condition in the Arctic region. This declaration, which was supported by Dr Scott, is all the more welcome since it ends the former conflict between the evidence of the fossil plants and animals; for the Cretaceous fauna of Greenland gives no indications of the warm climate that had been claimed on the evidence of the plants.

7. *The Upper Palaeozoic Glaciation*

The geological evidence which gives most support to belief in former abnormal climatic conditions is the Carboniferous and Lower Permian glaciation; for the presence of glacial deposits in central and north-western India, southern Africa, southern Brazil, and the Argentine, and at sea-level in north-western Australia and in New South Wales, suggests that the tropical and warm temperate zone once had an Arctic climate. In considering this question it should be remembered that glaciations at the present day are local phenomena. The two chief existing ice-caps, those of Greenland and of Antarctica, cover the two highlands nearest the poles. The mountain glaciations are in positions that receive a heavy snowfall, such as the Alps, the Himalaya, Alaska, Norway, the Alps of southern New Zealand, and the southern Andes; areas where the precipitation is smaller, although the climate may be colder, are free from glaciers.

The Pleistocene glaciations were also local. There were then at least four centres of glaciation in North America, and the glacial maxima of the British Isles, the Alps and Scandinavia, were apparently not synchronous; and this difference in time emphasizes the independent local growth and retreat of the glaciers. The greatest known Palaeozoic glaciation was in the Upper Carboniferous with some extension into the Permian. It was developed in a dozen or more centres, three in South Africa, two main areas in South America, two at least in India, the Central Provinces and Blaini, and five in Australia, viz. north-western Australia, New South Wales, Tasmania, Victoria and South Australia. The geographical conditions in each of these districts would have been favourable to heavy precipitation. These glaciations were on the coastal regions of Gondwanaland. Its western coast bordered the highlands of Brazil and the Argentine, where the moist winds from the South Pacific fed large snowfields. In South Africa a mountain range must have crossed Cape Colony and fronted the Southern Ocean; and as the wind threw against these mountains torrents of moist air, South Africa would have had a heavy snowfall.

Victoria, the mountains near Adelaide, Tasmania, and southern New South Wales were probably in the south-eastern corner of the same continent. Their geology shows that they were mountain lands; and their positions would have been favourable for heavy snowfall. Further north in Australia the glacial deposits disappear. In New South Wales they are well known north of Sydney, where some glacial drift was laid down in the sea; the dubious evidence further north indicates that the glacial action was slight or absent, and Queensland was north of the glaciation. In north-western Australia the geographical relations are less certain. Glacial and marine deposits are interbedded and the abundant free-swimming Goniatites (Agathiceras) indicate a temperature favourable to a fauna composed of large numbers of small individuals but few species; it included swarms of small cephalopods, which may have lived in a cool sea, and been killed by the inflow of colder water. An arm of the Southern Ocean may have extended northward off Western Australia and supplied both the moisture which fed the snowfields and the cold water that killed off shoals of the free-swimming organisms.

The glaciation in Central India is nearer the Equator than any low-level glaciation of the present day, but there is no evidence that these deposits were laid down at sea-level. The sea certainly lay not far to the north, and the moist air carried against the high mountains on the

northern front of Gondwanaland may well have nourished snowfields greater than those of the present Himalaya.

The glaciation of Gondwanaland was local in positions which the geographical conditions of the time rendered liable to heavy snowfall. The isolation of the glacial centres was probably original, and comparable to that of the Pleistocene and existing glaciations, and not due to the disruption of a once continuous glaciated area.

The view that the glaciation of Gondwanaland was all around the South Pole and that this Pole was then situated in South Africa is contradicted by the boulder clay at Squantum near Boston, U.S.A., which would have been on the Equator if the South Pole had been in Natal. The absence of contemporary glacial deposits in the British Carboniferous is sometimes attributed to there being no British representative of the subdivision that contains the Gondwanaland glacial beds. Though that may be true of the British Isles the explanation does not serve for the rest of Europe, as there are representatives of the Uralian (Stephanian) in France and Russia; and their deposits give no indication of glacial conditions.

8. *The Range of Drift Ice*

The fact that some of the Australian Gondwanaland glacial beds were laid down in the sea—such as a famous boulder which has been dropped into the Carboniferous marine deposits at Branxton in New South Wales—has been used as an argument for a climatic change so extreme as to require an astronomical cause, since they give evidence of ice at sea-level in areas where none is found at the present day. Occasional icebergs, however, often drift far nearer the tropics than their usual range, and explain occasional occurrences of far-carried boulders, such as that of granite in the chalk near London. The southern range of drift ice in the North Atlantic is at the latitude of 35° or that of Morocco. But even to-day, as in 1892, Antarctic ice sometimes reaches the latitude of 42° off New Zealand. In British waters in July 1902, a block of ice 50 ft. long, 2 ft. above water, so that it was 16 or 18 ft. thick, was encountered off the western coast of Mull in western Scotland, latitude 56½°. In October and November 1903, many large icebergs drifted into the area of 41–48° S., between 95 and 109° east, off the south-western corner of Australia. In 1894 a large block of ice was seen drifting northward in the South Atlantic at the latitude of 26° 30′, close to the southern tropic. Hence icebergs drift into the warm temperate and sub-tropical latitudes at the present day, and ice-borne erratics at a comparatively low latitude may be

due to the occasional passage of drift ice to localities beyond its usual range.

9. *Various Ancient Glaciations*

The other established pre-Pleistocene glaciations might be all explicable by geographical factors if we knew enough about them. Some present no difficulty as they occur in areas where severe climates still prevail. Thus the much controverted Huronian glaciation at Cobalt, Canada, lies north of Lake Superior which is icebound every winter. Moreover, according to the work of Bain, it occurred at the foot of a great mountain range; hence it is surprising that the direct evidence of ice-action on the boulders in the conglomerate is not more abundant and convincing.

The most puzzling of the early glaciations are those of Central China and South Australia. The glacial deposits of the Yangtze-kiang Valley west of Hankow in lat. 31° N. are not associated with marine beds, and may have been formed in a mountain area. The boulder clay in South Australia is not in contact with marine beds, but it lies 2000 ft. below the Middle Cambrian *Archeocyathus* limestones; the geographical conditions of its formation are also uncertain.

10. *Summary of Conclusions*

The main conclusions of this survey are that throughout the time of the fossiliferous rocks the physical and also the palaeontological evidence show that the earth's climate, considering of what a complex of factors it is the resultant, has been remarkably stable. The uniformity in the strength of the winds, the power of the surf, the size and weight of raindrops and sand grains show that the essential meteorological elements have been remarkably constant for all times of which we have direct evidence. There have been great local changes in climate, a locality that may now enjoy a warm temperate or even tropical climate having been formerly subject to glacial conditions; but these local changes are explicable by the geographical factors that produce such existing climatic anomalies as the pole of cold in eastern Siberia on much the same latitude as the Shetland Islands, and as the difference between the winter climates of Lisbon and New York. The claim that the climate was formerly uniform throughout the earth is contradicted by the evidence of the well-marked climatic zones, and of the limitation of coral reefs to the tropical and warm temperate zones and is not supported by any valid evidence from the distribution of fossil plants.

The established early glaciations, like those of the present time, and those of the early Pleistocene, were local developments in areas where the special geographical conditions of the time secured a heavy snowfall and a low summer temperature.

DR W. F. HUME said that he was in hearty agreement with Prof. Gregory as regards the general stability of climatic conditions throughout dated geological time. For instance, to take one point, the coral reefs of the larger Red Sea area in early Pliocene times, both in distribution and character, agree very closely with those of the same region in the present day. On the other hand, smaller climatic variations have evidently played a most important part in regard to human history in Egypt, and careful study should be undertaken along the lines already adopted by Huntington, Brooks and Pettersson. There are strong reasons for believing that rainfall was greater in Roman times in Egypt. Lately Prof. Newberry has been gathering together evidence which leads him to believe that the now sand-swept area of northern Sinai was the Land of Osiris, a land where cultivation of the cereals and later of the vine was well marked.

DR W. B. WRIGHT asked if Prof. Gregory could from his wide experience name a region where reef-building corals of Carboniferous age were operative on a scale equivalent to that of the present-day tropical reefs. He also enquired what special characters differentiated the Squantum "Till" from other conglomerate beds of Carboniferous age in similar latitudes, which have also been interpreted as boulder clays.

MR L. S. B. LEAKEY said that in Kenya the East African Archaeological Expedition during the season of 1926–7 found clear evidence of marked climatic changes in Pleistocene times. They had distinguished Pluvial and inter-Pluvial periods and considerable ice-advances on the mountains—during the Pluvial periods—including glaciation of mountains to-day unglaciated.

DR H. HAMSHAW THOMAS pointed out that the evidence from fossil plants was of supreme importance in determining climatic conditions in the past. Although palaeobotanists, such as Prof. Seward and Dr Scott, consider that there is no evidence for the existence of tropical or sub-tropical floras in the past in Arctic regions, yet there is ample evidence of a luxuriant Mesozoic vegetation in Greenland and Spitsbergen of a type now comparable only with that of far lower latitudes. The evidence from plants living on land in the air is of greater weight than the evidence from marine animals living in water owing to the difference in the physical properties of the two media. It seems difficult to account for the fossil plants of the Arctic regions on the theory of minor topographical changes.

MR BERNARD HOBSON observed that evidence of changes of climate from glaciation was not always trustworthy. For instance, within a few miles of Pontresina, with a pleasant summer climate, there were glaciers. Unless a large area shows evidence of glaciation a very severe climate could not necessarily be inferred.

PROF. J. W. GREGORY, in reply, remarked that in parts of North Africa there was evidence that in Roman times the rainfall was much the same as at present, but in pre-historic times it was greater, as a result of the southward diversion of rain storms during the Glacial Period. The same cause, as he had pointed out in 1895, in describing the glaciation of Mount Kenya, had given eastern Equatorial Africa a wetter climate, but that was long before historic time. He had mentioned the Squantum boulder clay as the best-known example of its class. He considered that coral reefs were formed in

the British Carboniferous seas, and then extended as far north as southern Scotland. He agreed with Dr Hamshaw Thomas that there had been a dense leafy vegetation in Greenland and Spitsbergen; but the Arctic foliage was often luxuriant, and dense vegetation still grew in Alaska upon the moraines of existing glaciers. The long daylight stimulates the growth of abundant foliage, which is characteristic of Arctic coal seams. He agreed with Sir Albert Kitson that in some parts of tropical Africa the dry areas were encroaching on the moist; but the reverse process was also taking place. In some areas the dunes were now dead owing to a covering of turf.

RECHERCHES SUR LES VARIATIONS DES CLIMATS AU COURS DE PÉRIODES GÉOLOGIQUES

PROF. P. FOURMARIER

It is regretted that limitation of space, and questions of expense, particularly in regard to a long series of illustrative maps, without which Prof. Fourmarier's paper would lose much of its value, preclude more than the statement of conclusions here reproduced.

CONCLUSIONS

1. Dans l'étude des anciens climats, les données de la géologie ne permettent aucune conclusion avant l'époque dévonienne. Il paraît y avoir une légère différenciation au Silurien, mais les différences de faciès pourraient résulter simplement de conditions différentes dans le milieu de sédimentation.

2. A partir du Dévonien, la différenciation commence à se manifester, puis va en s'accentuant jusque l'époque actuelle. Toutefois, le climat reste relativement chaud ou tempéré *sur toute la surface de la terre* jusque vers le milieu de la période tertiaire. A partir de ce moment seulement les conditions climatériques des régions polaires se montrent de plus en plus différentes de celles des régions équatoriales; les modifications se font relativement très vite surtout en comparaison de la très grande lenteur avec laquelle évoluaient les climats antérieurement.

3. En réalité, la courbe des variations n'est pas une courbe régulière; il s'est produit des oscillations, de telle manière qu'un diagramme prend une allure très complexe et montre notamment un relèvement pour passer de la période quaternaire à la période actuelle.

4. Il n'est pas douteux que l'hémisphère nord jouit d'une température moyenne plus élevée que l'hémisphère sud pendant la majeure partie de la durée des temps géologiques.

Au fur et à mesure qu'on se rapproche de l'époque actuelle, la différence va en s'atténuant et au quaternaire se produit une inversion; à cette époque, l'hémisphère nord, si l'on en juge par le développe-

ment des glaciers, avait une température moyenne inférieure à celle qui régnait dans l'hémisphère austral.

5. Quant à la cause de ces variations dans les conditions climatériques à la surface du globe, elle apparaît fort complexe et fort difficile à élucider. On ne peut cependant s'empêcher de croire que la cause principale est d'ordre général et par suite est en relation avec des modifications dans les conditions astronomiques. Le tracé des zones isoclimatiques permet de penser qu'il y eut probablement de légers déplacements des pôles à la surface de la Terre. Mais l'uniformité relative de la température, des pôles à l'équateur, jusqu'à une époque très proche de nous, fait penser à une modification de l'inclinaison de l'axe de la Terre sur le plan de l'écliptique. Si l'on suppose que l'axe des pôles soit perpendiculaire au plan de l'écliptique, il doit y avoir atténuation des différences climatériques entre les pôles et l'équateur; la température moyenne doit être plus uniforme, l'éclairage permanent des régions polaires compensant dans une large mesure l'obliquité des rayons solaires.

Les astronomes accepteront sans doute difficilement de se rallier à cette hypothèse, parce qu'une modification minime de l'inclinaison de l'axe des pôles nécessiterait un effort énorme. Or l'origine de cet effort devrait être cherché dans la Terre elle-même.

Les déformations subies par l'écorce terrestre, de façon continue, l'édification des chaînes de montagnes, la localisation des principales chaînes tertiaires comme les Alpes, les Carpathes, le Caucase, l'Himalaya dans l'hémisphère nord, ne sont-elles pas un facteur suffisant? Il ne faut pas perdre de vue, en effet, que de tels efforts ont agi pendant une durée de temps dont la longueur apparaît aujourd'hui formidable. Or, les grands changements dans les climats coïncident avec le début de la surrection des chaînes alpine et himalayenne.

N'y a-t-il pas eu aussi des déplacements des masses internes? C'est aux astronomes à nous dire si l'on peut envisager une telle hypothèse. S'il en était ainsi, la différence de climat entre les deux hémisphères s'expliquerait aisément. On sait l'influence des terres et des mers sur la déviation des isothermes dans l'état actuel de la surface du globe. Les géologues sont conduits à admettre que les noyaux des continents actuels ont toujours eu une tendance à être à l'état continental. Il en résulte que, pendant la majeure partie des temps géologiques, le domaine continental étant plus développé dans l'hémisphère nord, la température moyenne devait y être plus élevée. Au fur et à mesure qu'on se rapproche de la situation actuelle, la différence doit s'atténuer.

Si l'on pouvait même admettre qu'au quaternaire l'inclinaison de l'axe des pôles sur le plan de l'écliptique ait été moindre encore qu'aujourd'hui, on s'expliquerait non seulement le climat plus rigoureux régnant vers les pôles, mais encore le plus grand développement des glaciers autour du pôle nord, les continents intervenant cette fois comme masses refroidissantes.

On peut s'expliquer ainsi les variations oscillatoires des climats telles qu'elles résultent de l'étude de la flore crétacée par exemple.

Il est évident qu'il faut tenir compte aussi des causes secondaires, locales, d'origine géologique: la répartition des continents dont l'influence vient déjà d'être mise en lumière, la disposition et l'altitude des chaînes de montagnes facilitant le développement des glaciers, etc.

En conclusion, le facteur principal dans les variations des climats paraît bien être d'ordre astronomique. Lorsqu'il aura été parfaitement élucidé dans son mode d'action, les géologues pourront préciser davantage en mettant en lumière l'influence des déformations de l'écorce du globe.

For "Climate in Prehistoric Greece" by Prof. J. L. Myres, see p. 412.

THE NATURE AND ORIGIN OF THE LOESS DEPOSITS OF CHINA

PROF. G. B. BARBOUR

See *Smithsonian Report* for 1926, pp. 279–96.

Abstract

Much of the confusion surrounding the problem of the origin of the loess of North China has arisen through failure to distinguish between three types of superficial deposit—(i) a Tertiary residual "clay," locally re-worked, (ii) the true Loess of Middle Pleistocene age, which is essentially aeolian, and (iii) a younger series of gravel and loess beds in the formation of which both wind and water played a part. The prevalence of this third type, and the relatively slight development of true loess in the eastern provinces, have led to an undue reliance on stream-action as the original transporting agent of primary loess.

The bulk of the material was brought in from the north-west, where an abundant source of supply lay ready in the poorly consolidated younger basin sediments of Mongolia. The conclusions of the Central Asiatic Expedition point to the entire removal from the Gobi region of vast quantities of detritus. Only the finest material was carried out from the interior across the frontier of China. The coarser débris was

swept along until it was "fixed" by the vegetation of the moister marginal belt. No true loess occurs in Mongolia, and Teilhard has commented on the sandy facies of the borderland deposits in contrast to the finer grain of the loess in China proper.

Recent observations support the "vegetation theory" as the true explanation of the characteristic vertical cleavage; growth of the steppe grasses kept pace with the gradual accumulation of wind-transported dust.

The cave-dwellings and other features of the highly cultivated loess-lands are subjects of frequent comment. The importance of the loess as a determining factor in the early development of the civilization and characteristics of the Chinese people has been little appreciated. At a very early stage the life of prehistoric man was closely bound up with the loess, for the palaeolithic foyers noted by Licent and Teilhard occur only at the base of the deposit; thereafter the climatic conditions which marked the onset of loess accumulation were too severe for human life. At a much later date the proto-Chinese cultures first developed in the broad fertile valleys of the Kansu and Shensi loess-lands. Here the agricultural life of the people took root, gradually spreading down to the Yellow River Basin, which to-day still holds 100 of the 460 millions of the entire population.

For "Climatic Variations in Poland, etc." by Dr Marie Polaczek, see p. 413.

SUR LA VARIABILITÉ DU CLIMAT DANS LES ALPES FRANÇAISES

PROF. E. BÉNÉVENT

See *Le Climat des Alpes françaises*, 2^e Partie, chap. VII, pp. 197–235; et 3^e Partie, chap. VII, pp. 323–53. Paris: Chiron, 1926.

Mon but est surtout d'attirer l'attention, à l'occasion des travaux que j'ai été amené à faire sur le climat des Alpes françaises, sur l'intérêt que peut présenter l'étude de la variabilité des climats. Un climat ne peut se définir entièrement par l'analyse des moyennes de température ou de pluie; les moyennes permettent certes de voir clair dans la marche de phénomènes si capricieux; elles nous aident à connaître les lois générales qui régissent un climat; mais elles ne suffisent pas à donner la physionomie exacte de ce climat. Les régimes thermiques et pluviométriques peuvent varier beaucoup d'une année à l'autre. *La normale n'est qu'un accident*, et la nature semble se complaire à bouleverser à chaque instant les moyennes les mieux établies. Si je ne craignais de

pousser jusqu'au paradoxe, j'ajouterais volontiers, surtout en ce qui concerne les pluies, que la normale n'est intéressante que parce qu'elle permet par comparaison d'entrevoir dans quelle mesure la quantité et la fréquence des précipitations sont bien résolues à s'en écarter. Ainsi la variabilité des éléments météorologiques est un des côtés les plus caractéristiques de la physionomie d'un climat.

Or, l'étude de la variabilité me semble devoir poser deux problèmes bien distincts. Le premier consisterait à rechercher, à l'aide de séries d'observations les plus longues possible, si les mois ou les saisons s'écartent très également de la normale, ou si, au contraire, certaines saisons sont plus changeantes que d'autres; si l'influence de l'altitude et celle de la latitude n'interviennent pas pour accuser ou atténuer les caprices des saisons. Je me suis livré à l'étude de cette première question pour les phénomènes de température dans le domaine des Alpes françaises, magnifique champ d'expérience, non seulement par la variété des altitudes qu'il présente, mais encore parce que sa latitude lui vaut d'être à cheval sur deux zones climatiques: le nord est encore nettement sous l'influence atlantique, le sud appartient déjà au monde méditerranéen. En calculant la variabilité moyenne des mois et celle des saisons, c'est-à-dire l'écart moyen de la température d'un mois ou d'une saison de part et d'autre de la normale pour une période de 40 ans (1877–1916), je suis arrivé à un certain nombre de conclusions. Je me bornerai à en citer trois.

(1) *C'est la température moyenne des mois d'hiver qui présente dans toutes les Alpes françaises les plus grandes variations d'une année à l'autre.* De plus, ses sautes semblent s'aggraver davantage dans le nord des Alpes, à mesure que le climat devient plus continental. *Les mois d'été, au contraire, sont en général les moins capricieux*; et pourtant l'écart moyen de la température d'un mois d'été est encore de 0°9 à 1°2, suivant les lieux. Notons que cela équivaut en montagne à un déplacement en altitude de près de 200 m. Et si l'on recherche les mois d'été qui ont été particulièrement anormaux au cours de la période 1877–1916, on constate que l'écart à la normale peut atteindre $\pm 2\frac{1}{2}°$. Ainsi d'une année à l'autre, la température peut varier de 4 à 5°, ce qui équivaut à un déplacement de 800 m. en altitude ou de 4 à 5° en latitude. Tel village situé à 1800 m. d'altitude, par exemple, peut être déplacé en quelque sorte par les variations thermiques extrêmes entre 1400 et 2200 m. On prévoit les conséquences que peuvent avoir de pareilles variations surtout pour les villages qui sont situés près de la limite d'altitude au delà de laquelle les récoltes ne mûrissent plus.

(2) *La variabilité des saisons est plus marquée dans les hauteurs que dans les basses vallées*, particulièrement au printemps et en automne. Je pense qu'il faut en chercher la raison dans l'influence de la neige. Au printemps et en automne, la neige visite rarement les parties basses; en tout cas il est rare qu'elle y séjourne longtemps. Dans les hauteurs, au contraire, en ces deux saisons la neige constitue un manteau plus durable et comme elle augmente le rayonnement, la température y sera relativement moins élevée que dans les basses vallées. Si, au contraire, par un concours de circonstances favorables, la neige vient à disparaître plus rapidement que d'ordinaire au printemps, ou si en automne elle tarde à faire son apparition, la température s'élèvera davantage au-dessus de la normale dans les hauteurs que dans les régions de faible altitude. Ceci me paraît être vrai jusqu'aux limites supérieures de la zone habitée (2000 m.). Plus haut, lorsque le manteau de neige devient plus durable, ne disparaît qu'en été, ou même pas du tout, la variabilité revêt peut-être un tout autre caractère, mais le manque absolu d'observations à de si grandes hauteurs ne m'a pas permis de l'établir.

(3) *La variabilité des saisons est plus marquée dans le Nord des Alpes soumis aux influences de l'Océan, que dans les régions méridionales orientées vers la Méditerranée. A priori* cette conclusion pourrait sembler paradoxale; que devient en effet l'action régulatrice que l'on accorde à l'Océan? Et pourtant les faits sont là, qui demandent une explication. Observons en effet que la variabilité de la température moyenne doit être en rapport direct avec les variations du régime des vents: si des vents chauds ou des vents froids soufflent avec plus de fréquence que d'ordinaire, il y aura, suivant le cas, apport supplémentaire de chaleur ou de froid. Or, les variations du régime des vents sont elles-mêmes fonction de la fréquence des perturbations atmosphériques. En définitive, les régions où les saisons étalent le plus fortement leurs caprices sont donc probablement celles où le régime normal des vents risque d'être davantage bouleversé par les changements barométriques qui se produisent dans le nord-ouest de l'Europe. Le Nord des Alpes françaises est passible de fluctuations saisonnières plus marquées parce qu'il est sous le contrôle de l'Atlantique, origine des perturbations. Dans les Alpes du Sud, au contraire, les saisons restent plus semblables à elles-mêmes parce que cette partie de la grande chaîne, orientée climatiquement vers la Méditerranée, est soumise à des conditions barométriques plus constantes.

Tel est le premier genre de questions que pose l'étude de la variabilité. Mais ces questions une fois résolues, un autre problème

surgit. N'est-il pas logique en effet de se demander si les fluctuations de la température moyenne ou de la quantité moyenne des précipitations de part et d'autre de la normale sont simplement le jeu du hasard, ou si, au contraire, elles ne se reproduiraient pas avec quelque régularité ? Divers auteurs, Hellmann par exemple pour Berlin, ont cru trouver un certain rythme dans la succession des saisons très froides et des saisons très chaudes; les règles de Hellmann ne trouvent pas leur confirmation dans le climat des Alpes françaises; elles n'ont vraisemblablement qu'une valeur locale. Il nous semble possible d'accorder plus de confiance au rythme mieux marqué de la température annuelle. Au cours de la période 1877–1916 les années froides et les années chaudes ont paru se suivre par séries assez nettes. Le phénomène devient surtout évident, si, pour éliminer les accidents, on raisonne non plus sur les moyennes annuelles, mais sur les moyennes de cinq ans (1877–1881, 1878–1882, 1879–1883, 1912–1916). Les graphiques construits avec ces données nouvelles dessinent de grandes ondulations. Ils montrent qu'une période froide semble avoir pris fin dans nos Alpes vers 1891. Une série d'années chaudes a suivi jusqu'en 1905 ou 1910 suivant les lieux. Depuis cette date une nouvelle période plus froide paraît se développer. On retrouve donc, dans le climat des Alpes françaises, des variations qui rappellent quelque peu le cycle de 35 ans de Brückner. Mais ces oscillations climatiques ne sont pas toujours rigoureusement synchroniques: la dernière série froide citée par Brückner s'étend de 1871 à 1885; or, en ce qui concerne les Alpes françaises, il faut étendre cette période froide jusqu'en 1891. De même, la période chaude qui a suivi n'a pas pris fin partout au même moment: si elle s'est terminée en 1905 dans le sud des Alpes, elle paraît s'être prolongée jusqu'en 1911 dans le nord de la chaîne. Ainsi, il ne semble pas qu'on puisse vraiment parler de périodicité réelle; il s'agit plutôt d'oscillations se succédant à intervalles trop variables pour qu'on puisse en prévoir avec quelque certitude le retour.

Or, l'étude des précipitations annuelles vient renforcer singulièrement cette opinion. La périodicité cherchée par Brückner est encore moins nette que pour les phénomènes thermiques; bien plus, les fluctuations de la pluviosité ne concordent pas toujours avec celles de la température. D'après Brückner les années chaudes seraient aussi des années sèches. Or, en calculant les moyennes de pluie quinquennales, comme pour la température, on obtient aussi sur les graphiques de grandes ondulations. Mais, ces oscillations de la pluviosité ne s'opposent pas nécessairement aux oscillations thermiques de part et d'autre de la normale; les lignes sont parfois l'une et l'autre

en même temps au-dessus ou au-dessous de la normale. Toutefois, si l'alternance de périodes sèches et de périodes humides d'une durée de 15 à 20 ans n'est pas nettement établie, il n'est pas impossible de reconnaître sur les graphiques des phases pluvieuses et des phases sèches de moindre ampleur et se succédant avec un certain rythme:

Phase humide	... ...	——	finissant vers 1889
sèche	... ...	1890	à 1894 ou 1895
humide	... ...	1895	à 1903
sèche	... ...	1904	à 1909
humide	... ...	1909	à 1917
sèche	débutant vers	1917	ou 1918

Ainsi la durée de ces diverses oscillations est d'environ six à neuf ans. Mais la période envisagée (40 ans) est trop courte pour qu'on préjuge de l'avenir.

En terminant ce très bref exposé, qu'il me soit permis d'insister sur un point capital: des études de ce genre ne peuvent être entreprises qu'avec des observations dont on est tout à fait sûr. L'utilisation de données dont l'authenticité n'est pas contrôlable risquerait d'obscurcir la question et de conduire à des résultats absurdes ou pour le moins contradictoires. C'est pourquoi il est difficile de remonter très loin dans le passé. Du moins souhaité-je vivement l'apparition d'autres travaux sur le climat des cinquante dernières années dans d'autres contrées de la zone tempérée: ceux de la région boréale permettraient de voir s'il faut attribuer à ces fluctuations de climat une valeur générale; ceux de la région australe nous montreraient si les oscillations climatiques sont de même sens ou de sens inverse dans les deux hémisphères. Peut-être pourrait-on alors essayer de rechercher les raisons de ces variations, raisons qui pour le moment paraissent encore totalement inconnues.

PROJET D'UNE ÉTUDE A COLLABORATION INTERNATIONALE SUR LES VARIATIONS DES CLIMATS PRÉSENTÉ PAR LE COMITÉ GÉOGRAPHIQUE ITALIEN

PROF. L. DE MARCHI

La question d'une étude sur les changements des climats a été remise à ce Congrès par le Congrès du Caire. M. le Président a voulu qu'elle fût présentée par une relation programmatique d'ensemble, la discussion de laquelle puisse porter à des délibérations concrètes.

C'est en obéissant à cet ordre que nous avons préparé, moi et mon collègue le Prof. Negri, la relation que nous avons l'honneur de présenter. Elle n'a pas tout à fait la prétention d'un vrai programme: celui-ci devra être formulé dans tous ses détails par une ou plusieurs Commissions.

Je dis par une ou plusieurs, ou, si vous voulez, par une Commission, formée par plusieurs (et je pense trois) sous-commissions, parce que, comme il est signalé dans le résumé de notre relation publiée dans l'*Handbook*, le problème doit être approché par des voies bien différentes, par la voie historique, par la voie physique et par la voie biologique.

Le recueil des documents historiques devra être assigné à des experts de géographie historique, à des historiens, à des connaisseurs des archives nationaux et locales et même, pour les périodes plus anciennes, à des philologues et à des archéologues, car il s'agira aussi du dépouillement des monuments de littérature, dans toutes les langues modernes et anciennes d'art et d'antiquité historique et préhistorique.

Le recueil des documents physiques (de météorologie, d'hydrologie, de glaciologie, etc.) ne pourrait être au contraire assigné qu'à des experts de ces sciences, et il sera nécessaire à cette fin d'établir une entente avec l'Union Géodésique et Géophysique.

Enfin, les documents biologiques ne pourraient être recueillis et discutés que par des biologues, et surtout par des botaniciens, car c'est surtout dans la végétation que se réfléchissent les conditions d'ambiant physique pendant que les animaux s'en soustraient plus facilement par l'adaptation et l'émigration. Mais c'est là une question dont la définition doit être laissée à la Commission qui sera chargée du programme définitif. Cependant, nous voyons encore là la nécessité d'une entente avec les Comités biologiques. Dans notre relation, le Prof. Negri a rappelé quelques faits (anneaux de croissance, limites géographiques et altimétriques des formations végétales, débris de végétation ancienne, restes végétaux et animales dans les tourbières) qui dans ces derniers temps ont conduit à quelques conclusions plus ou moins sûres en relation aux climats postglaciaires, préhistoriques et aussi historiques. A la connaissance de tous sont les hardies applications de ces observations, qu'ont été faites récemment à l'explication de l'histoire.

Les maximes générales que nous avons cru pouvoir soumettre à votre discussion, sont les suivantes:

(1) Puisque dans chacune des voies que nous voyons tracées à notre recherche on a travaillé déjà dans tous les pays, par des initiatives

dispersées mais quand même très précieuses, nous proposons que chaque Comité national veuille donner ses soins à une bibliographie, la plus complète possible, de tous les ouvrages se rapportant à des variations générales ou locales de climat.

(2) Nous croyons que l'étude doit être limitée à la période historique et préhistorique, en laissant de côté, pour le moment, le problème des climats géologiques.

(3) Nous croyons de plus que le travail devrait, dans un premier temps, se restreindre à un simple recueil tout à fait objectif des documents; les savants chargés de cette tâche devraient faire abstraction de toute théorie, et renoncer à des conclusions qui pourraient être prématurées.

(4) Les documents historiques devraient être classés chronologiquement: on devrait faire les *Annales des climats*, avec la même méthode suivie par un savant italien, le Prof. Baratta, pour sa compilation très précieuse des *Annales des tremblements de terre en Italie*. La comparaison de ces fragments d'Annales recueillis par chaque Comité national, donnera, nous espérons, quelque résultat positif sur les variations progressives, ou périodiques, en phase concordante ou discordante dans les différentes régions, pendant les siècles et les âges précédents.

(5) Les documents météorologiques, hydrologiques, etc., ne se rapportent qu'à deux siècles à peu près. Nous avons un modèle de discussion de ces données dans l'œuvre classique "*Klimaschwankungen seit* 1700" de Eduard Brückner dont nous regrettons la perte récente. Il faudra suivre la voie tracée par lui avec une documentation bien plus riche par le nombre des stations et par 40 ans en plus d'observation. Mais aussi dans ce cas, on devrait oublier la période de Brückner et toute période qui soit apparue à d'autres synthétisateurs de faits météorologiques. Les données de mesure devraient être assujetties à une analyse périodale et complète des moyennes mensuelles et annuelles, et peut-être il conviendra de considérer au lieu de l'année solaire, l'année hydrologique, de octobre à septembre, pour mieux rallier les faits de la météorologie aux débits des rivières et aux variations des fleuves et des glaciers.

C'est dans ces termes qu'il faut, selon nous, poser le problème et formuler l'ordre du jour, si l'Assemblée croira bien de confier au Conseil de l'Union Internationale la nomination des Commissions dont j'ai parlé tout à l'heure.

PROF. EMM. DE MARTONNE then formally proposed a resolution in this sense, for the text of which see pp. 46–7.

PROF. J. W. GREGORY supported Prof. de Martonne's suggestion that the work of the proposed Commission be limited to the historic period, in order to avoid overlap with the projected International Congress on Quaternary Geology, and he suggested further the advisability of limiting the work to countries which adhere to the Research Council. Institutions, like individuals, must put up with the limitations of their country.

23 JULY

SOME REMARKS UPON INTERIOR BASIN DRAINAGE

PROF. E. ROMER and J. SABATOWSKA

[*Read by* Prof. E. Romer]

Abstract

Berghaus's small hydrographic planisphere has been for the last 40 years the only considerable source of information relating to this problem. Prof. E. de Martonne, employing the copious new cartographic material, which has been accumulating in the meantime, has directed this problem into entirely new paths. It was de Martonne also who introduced into science the new notions of exoreism, endoreism, and areism.

Owing to the complexity of the various geographic relations, as well as varying deficiencies in survey, the exact application of these notions still meets with some difficulties. Hence the map of interior basin drainage constructed by de Martonne suggests doubts in more than one particular. One of the numerous examples is the inclusion of Yucatan, the Hungarian Plain, West Siberia, or the Sungari Basin of Manchuria in the areic domain.

The indices of aridity for these regions are: 65, 32, 28, 32, and 36 respectively, *i.e.* with no figure much lower than that of the index for London, 32. The doubts as to de Martonne's formula for an index of aridity, raised by the above and similar considerations, have finally led to the formula $Ar = \frac{Te \cdot C}{P}$, in which Te is the mean temperature of the three hottest months, C is the pressure of vapour at a given temperature, divided by this pressure at 0°, and P is the annual precipitation.

A still greater difficulty than these details is raised by the fact that with the present state of cartography a precise application of de Martonne's ideas is out of the question. But even when we consider it from a purely theoretical point of view, we cannot escape certain doubts. The distinction of the areic regions transfers a certain number of the endoreic areas to the middle and high mountain deserts, thereby depriving these regions of their connection with the morphological

basins, hence also of morphological criteria, while failing, on the other hand, to secure to these two geographical notions any strict definition based on climatic conditions. This explains the instability in classification of these areas shown in the studies of de Martonne (*C.R. Cairo*, 1925, and *G. Review*, 1927). The following example may suffice:

Surface in 1000 *km.*² *of Interior Basin Drainage according to de Martonne*

	Endoreic area				Areic area			
	13–34° N.	diff.	26–33° S.	diff.	13–34° N.	diff.	26–33° S.	diff.
1924	16,522	6·5 %	3293	1·5 %	11,140	29·6 %	1662	48·3 %
1927	17,635	1·3 %	3332	16·7 %	14,479	0·0 %	2464	16·2 %
1928	17,863		3888		14,471		2864	

The Surface of Areic in per cent. of Endoreic Domain

	1924	1927	1928
13–34 N.	69·0	82·1	81·0
26–33 S.	50·5	74·0	73·7

The variation in the above figures is obviously due, in the first place, to imperfect surveying.

But leaving one theory out of account in dealing with practical difficulties, another theoretical feature suggests itself in this problem. One of the main criteria distinguishing interior from oceanic basin drainage is the *régime hydrologique*—especially the difference between the maximum and minimum of flow in the river channels. These differences are so great, even in the exoreic domain, that they raise doubts as to whether interior basin drainage can be strictly demarcated from exterior even on this basis. On the other hand, however, the fact cannot be overlooked that even in typical oceanic basins the bulk of morphogenetic action takes place during high floods. Hence the question arises whether the ephemeric deluges on the periphery of the steppes and deserts do not produce analogous morphogenetic results, and if so, to what extent? Detailed hypsographic studies might supply criteria for a greater or less degree of relief concavity and become the basis, or in any case one of the bases, for a morphogenetic distinction of interior basin drainage.

But before arriving at a fixed method for the consideration of this problem along these and similar lines, it seems to me that there is still something to be said in favour of the old and general conception of interior basin drainage in the Berghaus sense, at least from a didactic

point of view. I take the liberty of giving here the figures obtained in my University Institute, which were used in diagrammatic demonstration in my *Universal Atlas*, 1925. It is remarkable how little these figures differ from Penck's values based on Berghaus's map, though the maps on which my figures are based may be taken to represent the cartography in 1910. In the following table, figures relating to the endoreic domain given by de Martonne have also been added.

Surface of Interior Basin Drainage in 1,000,000 *km.*^{2}

	Europe	Asia	Africa	Australia	North America	South America
Romer	1·7	12·4	10·8	4·1	0·1	1·4
Penck	1·6	12·6	9·6	4·0	0·9	1·2
de Martonne	2·2	14·8	15·2	4·9	2·1	2·5

Calculations on entirely new cartographic material (1922–7) have been undertaken.

PROF. EMM. DE MARTONNE: Je remercie mon collègue et ami Romer non seulement pour ses éloges, mais aussi pour ses critiques; toutes les observations que nos collègues voudront bien envoyer aux auteurs du *Mémoire sur les Régions privées d'écoulement* seront les bienvenues. Je suis d'accord avec Romer pour dire que nos connaissances cartographiques sont encore insuffisantes pour pouvoir donner un tableau définitif. Si les chiffres cités sont aussi différents, c'est que nous avons graduellement perfectionné notre travail. Le tableau présenté dans le Rapport distribué aux membres du Congrès correspond aussi exactement que possible à l'état actuel de nos connaissances. Il faut noter cependant que si nous avons modifié progressivement nos chiffres, ce n'est pas seulement par la considération de nouveaux documents cartographiques, mais parce que nous avons perfectionné la méthode de recherche et dégagé un certain nombre d'idées nouvelles. Ces idées, présentées dans le Rapport, me semblent répondre à la plupart des observations de Romer. L'indice d'aridité ne saurait tout expliquer. A côté de l'aréïsme climatique, il faut distinguer l'aréïsme orographique, l'aréïsme géologique et ce qu'on pourrait peut-être appeler l'aréïsme historique. Ce dernier cas répond à une idée que j'estime capitale; les phénomènes hydrographiques, comme bien d'autres phénomènes géographiques ne peuvent s'expliquer complètement par la seule considération des conditions actuelles; il reste un résidu du passé.

En ce qui concerne l'indice d'aridité je ferai remarquer que la formule très simple que j'ai proposée est jusqu'à présent celle qui a donné les meilleurs résultats. Elle a permis de dresser non seulement la carte générale assez grossière, qui est reproduite dans le Rapport, mais déjà une série de cartes spéciales détaillées qui seront prochainement publiées pour la France, les États Unis, l'Algérie, la Tunisie, le Mexique. Il semble bien douteux que la formule proposée par le Prof. Romer puisse donner des résultats pour l'ensemble du globe; car les trois mois les plus chauds, qui sont seuls pris en considération, peuvent tomber soit dans la saison sèche, soit dans la saison des pluies. Quant aux chiffres donnés par mon collègue pour l'indice d'aridité, on peut se demander s'ils ne sont pas des fautes d'impression. Il est impossible que le Yucatan, en particulier, donne 65. Je crois qu'un des membres du Congrès, connaissant personnellement le Yucatan, sera de cet avis.

MLLE ROSA FILATTI said that, using the formula of Prof. de Martonne, she had drawn up a map of Aridity Indices for Mexico, making use of the information supplied by the "Commission d'Études Géographiques et Climatologiques" in its "Atlas Météorologique," which includes the period 1921–5, and which moreover is the only document of value for the purpose. In the Mexican Republic there are 276 meteorological stations, of which 7 are in Yucatan. According to her calculations the indices were as follows:

Progreso ...	14·4	Champotón ...	31·8
Merida	25·5	Valladolid ...	37·2
Maxcanú ...	26·4	P. Obispo ...	39·3
Campeche ...	25·5		

Having travelled through the peninsula for the purpose of making geographical investigations, she had been able to ascertain that the values given correspond exactly to reality. In the north-west the aridity is extremely striking in regard both to drainage and to biology. Life for plants and animals is difficult and sometimes impossible. Only the henequen or sisal agave resists the drought on account of its long roots which penetrate into the Karst surface in order to get water. The population has to make use for all its needs of alkaline water from wells or of rain-water caught in *algibes*. The calcareous soil of this region explains the subterranean circulation in the caverns called *cenotes* or *aguadas*. It is only in the middle and east, where the figures are a little higher, that first the steppe and then the forest gradually make their appearance.

PROF. ROMER, replying to the remarks of Prof. de Martonne and of Mlle Filatti, said that all the figures given in his abstract were based upon the "Réseau Mondial." The index deduced for Yucatan is above 60, while that for London, Budapest, Bucarest, Tobolsk and Sungari (after Hann) are all about 30. Even according to de Martonne's formula the index in Manchuria is higher than that of London. These figures were quoted as examples to show that the formula was not applicable for the whole world. The question of an index of aridity was in fact very complex, as numerous studies undertaken by himself and by his students had revealed. The aridity of a climate was in his opinion better indicated by the temperature of the hottest months than by reference to the annual temperature.

The following table affords a comparison of results:

	Scilly Is.	London	Budapest	Bucharest	Tobolsk	Sungari
de Martonne	65	30	32	28	32	36
Romer	3	8	9	12	14	11

While, as Mlle Filatti has proved, de Martonne's formula gives good results for Yucatan, the same formula applied to Poland yields little but contradictions. Two facts must be taken into account: (*a*) the present state of world cartography does not permit a quantitative treatment which will accord with the qualitative distinctions made by de Martonne; (*b*) the quantitative treatment yields only climatological results, whereas the question of Interior Basin Drainage, to which the qualitative methods are appropriate, has to take into account phenomena of geology, of morphology and even of history. The two problems must then continue to demand separate treatment.

THE SIGNIFICANCE OF FOLDING AND FAULTING IN THE OROGRAPHY OF EGYPT AND SINAI

W. F. HUME, D. SC., F.R.S.E., etc.

At the last International Geographical Congress, held at Cairo in 1925, Dr Ball gave an account of the progress of the survey of the Egyptian desert regions during the last 20 years. In it he pointed out how more exact data were being accumulated and what a wide field still remained for closer study. His paper, and that on "The Atlas of Egypt," presented by Hussein Sirry Bey, Surveyor-General of Egypt, to the present Congress, place geographers in possession of the latest results achieved in this field. The present contribution has as its aim to give some of the evidence obtained in recent years, which tends to show how great a part surface dislocations (themselves the results of deeper-seated movements) have played in determining the surface features in Egypt and Sinai.

THE PENINSULA OF SINAI

During the period under review the whole of the Peninsula of Sinai has been completely mapped by various sections of the Survey of Egypt, with a certain amount of extraneous aid from military surveyors. This area falls within the region which has become classical as being that of the *Great Rifts*.

1. *The Rifts of Southern Sinai*

The detailed study of Southern Sinai indicated that the main mountain system of this portion of the peninsula consists of a series of long crests (separated by high passes), gradually lowering from 2592 m. above sea-level at its northern extremity to sea-level at Ras Muhammad. The principal chain is bordered by a secondary longitudinal system, lower than the former in the northern half of the area, but, together with the east–west spurs thrown off from it, rivalling it in the southern half. From Wadi Hebran to Ras Muhammad only two easy passes cross the chain, two others also being available for baggage camels.

East of Fersh Sheikh el 'Arab a transverse system runs west and east to the Gulf of 'Aqaba, the general level of the country to the

north of it being higher than that to the south. The transverse watershed is identical with the transverse chain at most of the important points. The transverse chain separates two districts, which are topographically distinct. The one to the north still retains much of the original plateau character, and has an average height of over 1220 m. above sea-level, except where it is cut through by deep, narrow gorges. The *southern area*, on the other hand, is cut up into a multitude of ranges and peaks, the plateau character having disappeared.

The transverse chain is crossed by five passes (two being available for baggage camels) which have the remarkable feature in common that the valleys they connect form five roughly straight grooves, all parallel to one another and to the Gulf of 'Aqaba, that is in a direction somewhat west of south. It was concluded that these continuous clefts were true rift-valleys, one of these, the Shelala—Umm Raiyig Rift—being studied in some detail. Its main characteristics may be regarded as typical of these rift-valleys as a whole, these being as follows:

(1) Its length, which was about 72 km.

(2) Its *almost perfectly straight character*; there being only a slight bend where Wadi Nasb turns east at the mouth of Wadi Umm Raiyig.

(3) The *steep slopes* of the bounding hills throughout the greater part of its course.

(4) The occasional diversity of geological structure on both sides of the valley, this being especially marked where the red granite range of Ashara on the west stands in sharp contrast to the dark schistose hills of Ferani.

(5) Most important of all is the letting down of younger beds along the line. The present writer wrote in 1900[1]: "Yet scattered all along its course are low hills of white Nubian sandstone, and in one place Cenomanian limestone, so that the surprising result is realized, that Cretaceous fossils are collected from a limestone, on both sides of which tower granite cliffs to a height of over 500 m., the extent of dislocation being here at least 700 m."

In addition to the five very definite rifts thus proved to exist in Southern Sinai, a great mass of detailed information has been collected as to the fault-systems which are present on both sides of the peninsula in the areas bounding the Gulf of Suez and 'Aqaba. Erosion, as in the case of the rifts, has taken advantage of the geological diversity produced by the fractures, so that the present variety of

[1] "The Rift Valleys of Eastern Sinai," *Intern. Geol. Congress*, Paris, August 1900.

mountain, valley and plain is in large measure directly due to the tectonic changes to which the peninsula has been subject. As an example, the great mountain wall which, as seen from Tor, extends for many miles in a north-west and south-east direction parallel to the Gulf of Suez, is apparently determined by a gigantic fault, highly disturbed Cretaceous beds being found at the base of its slopes at several localities.

The nature of these complex disturbances is very clearly displayed along the road which the Sinai Manganese Co. has constructed from its port at Abu Zenima, on the Gulf of Suez, to the mines of Umm Bogma, some miles inland, and 2000 ft. above the sea. At the mouth of Wadi Shellal, where it issues into the Markha plain, the deep red Carboniferous sandstone is seen to crown the very summit of the green-tinted schistose or reddish granitic hills. Then masses of the same sandstone are observed poised by a series of step-faults, at various levels on the sides of the hills, until finally there is a considerable exposure of it in the floor of the Wadi Shellal. Looking eastward toward the plain the whole scene changes. The steep red and green hills with their red sandstone cappings are abruptly replaced by limestones of every shade of tint from cream-white to dark reddish yellow. Near the fault-line which they mark, these Cretaceous beds stand at high angles, and form sharp ridges of imposing height. From here to the sea there is a bewildering maze of these calcareous strata, Cretaceous, Eocene and Miocene in age, which are broken by faults, bent by folds, eroded into sharp crests and narrow valleys, a typical bad-land area presenting a picture of topographical confusion.

The faulted areas bordering the Gulf of ‘Aqaba display equal complexities.

2. *The Fold Systems of Northern Sinai*

The northern portion of the peninsula of Sinai does not, however, display these complex fault-systems, but a new and striking series of tectonic features determines its topography. Attention has been directed of late years to the remarkable north-north-east and south-south-west trending fold ranges which form the most prominent characteristic north of latitude 30° N. in Sinai. Plate III in the *Petroleum Research Bulletin*, No. 10, 1921, by F. W. Moon and H. Sadek, indicates the existence of three distinct axes having this general trend. These give rise to a series of conspicuous hills, the geology of which has been closely studied since Barthoux first noted the presence of Jurassic strata in Gebel Maghara. The three axes are:

(1) The Hamaiyir—Mafruth—Reisan axis; (2) the Maghara axis;

(3) the Giddi—Yelleg—Hellal axis. In the same plate is shown the north and south trending fault which bounds the main Sinai Peninsula to the west. Plate V in the same work gives a section across these folds, and it is clearly brought to view that they are all marked by having their steepest dip on the south-eastern side. This certainly suggests that the impulse to folding was from the north-west. "Geologically they are asymmetrical elongated domes of the diaper type, with dips of 5° to 10° on the north-west flanks and almost reaching verticality on the south-east. So much so, that the succession of rocks extending in large dip planes on the north-west flanks are usually crowded into a thin ridge on the south-east[1]."

Another feature in Northern Sinai was brought to light during the Petroleum Research expeditions of recent years. This was the presence of a series of smaller domes (Gebels Minshera, Jaifa, and Hamra are examples of one series, and Gebels Khrim, Burga, and Aneiga of another). These smaller domes, being aligned in the same north-north-east and south-south-west lines as the bigger folds already mentioned, must belong to the same series of movements which brought the latter into being.

3. *Transverse Fractures in the Sinai Peninsula*

The disturbances in the peninsula have been sometimes accompanied by the extrusion of masses of basalt, which in places have risen along fault-lines. Extending across the peninsula in about latitude 29° 40′ N. and crossing the undisturbed plain are two structure-lines. The one is the line of dolerite or basaltic dyke which can be followed from Gebel Somar eastwards for 50 km. or more in a straight line. Where it traverses the soft white chalk, this black dyke stands up like a railway embankment, while in limestone country the limestone, hardened at the contact, stands up on either side of the groove left after the denudation of the softer dyke rock. The other feature, also having a general east and west trend, "is a fault marked by steep dips manifested in the sharp uplifts of the hills of Gebel Meneidra, etc., which may be prolonged eastward to join the fault bordering the scarps south of Bir El Themed[2]."

Beadnell studied the central part of the peninsula in connection with the Petroleum Research of the Egyptian Government. His conclusions are summarized in a figure on p. 23 of his *The Wilderness of Sinai*, 1927. On p. 24 he refers to the competing opinions of Gregory

[1] Sadek, H., "A Scientific Study of Scenery in Sinai," *Compte-Rendu Cong. Intern. de Géogr.*, Cairo, 1925, p. 147.

[2] Sadek, *loc. cit.* p. 149.

and Ball on the origin of the Gulf of Suez, the former classing it as a rift-valley. His own conclusion from what he saw in the Abu Qada district in Sinai, and from his consideration of the fractures mapped to the north and south by earlier expeditions, in conjunction with the dislocations known on the western side of the Gulf, was that the whole of the great low-lying basin occupied by the Gulf of Suez and the maritime plains is either a foundered tract or an area which has failed to participate in the general upward movement of the crust. "This elevation coincided with the commencement of the last great period of mountain building—the so-called Alpine revolution—which gave rise to the Alps and Himalayas—and culminated in the formation of those great tablelands which are such a feature of Egypt and Central Sinai."

4. *The North-west Trending Fold of Gebel 'Araba*

The special geographical interest of the Sinai Peninsula is increased by the presence on its south-western edge north of Tor of the range of Gebel 'Araba. This consists of the succession of strata typical of the region which bounds the southern end of the Gulf of Suez. The high-peaked hill, the Asses' Ears, nearest the sea, is granite, and passing eastward and inward from it, the whole succession of Nubian sandstone, Cretaceous, Eocene, and Miocene beds is met with until, the Qa plain being reached, all the strata of later age than these are buried beneath the thick covering of detrital materials brought down by torrent action from the higher ranges of Southern Sinai.

The origin of the 'Araba range must be similar to that of the Esh and Zeit ranges on the western side of the Gulf of Suez. The great feature common to the two last named is the gradually diminishing dip of the sedimentary strata outward from and to the west of the granite ranges forming their central core, as compared with the sharp monoclinal character of the Miocene and later coral-reef which lines the hills as a plaster on their eastern flank. In these instances the granite behaves as though it had been a solid wedge driven through the overlying softer strata; the beds near the granitic apex of the anticline are greatly reduced in thickness, and on the steeper side of the arch in extreme cases are pinched out, or otherwise violently dislocated. This point of uplift has been emphasized by O. H. Little[1] in his study of the Safaga Range on the west coast of the Red Sea.

The geological research of the last thirty years in Sinai has now

[1] "Note on the Neogene Formations of Egypt along the northern part of the Red Sea," *Congr. Intern. XIII^e Session,* Belgique, 1922, p. 987, fig. 1.

supplied a generalized idea of the tectonic relationships, which will serve as a basis for further and more detailed study. By the differential action of erosion on the limestone, sandstone, and igneous and metamorphic rocks thus fractured and folded, has resulted all the complexity of surface structure which makes the peninsula of Sinai so fascinating a region of study for the geographer.

It will be an interesting study to determine how far isostasy will explain the variety of tectonic conditions observed in Sinai and along the Egyptian borders of the Erythraean depression.

5. *The Tectonic Characteristics of Egypt* (sensu stricto)

A great advance has been made in the study of Desert Egypt as a whole, in so far as triangulation and general mapping is concerned. When, however, we begin to examine the causes underlying the surface features, it is found that a vast amount of detailed information is still needed in order to explain even the most conspicuous of these. Several north-east and south-west trending folds are indicated, which may be of great importance. The most northerly of these is the one which gives rise to the elevated area of Gebel Ataqa, the Muqattam hills above Cairo, and the Abu Ruwash hills north of the Pyramids. One of the interesting questions of Libyan desert structure will be to try and trace the continuation of this fold to the westward, though the widespread Miocene strata hide much of the underlying structure. It seems desirable also to have some general name for this group of north-east and south-west trending folds. As they are apparently directed from the region which was occupied by the Tethys, or greater Mediterranean, we would suggest the term *Tethyan Fold* for this series, which may play a by no means unimportant part in the formation of some of the major geographical features of Egyptian scenery. A second fold of this nature appears to determine the presence of the northern and southern Qalala limestone hills, while between them the erosion of the underlying Nubian sandstone has led to the formation of the deep Wadi 'Araba. A third fold of great significance in the structure of the Nile Valley is the one which seems to have determined the great bend of the Nile in the neighbourhood of Qena and Luxor. Each of these folds is associated with fractures. For instance, there is much faulting in the Gebel Ataqa region and in the neighbourhood of Cairo in possible connection with the Ataqa-Abu Ruwash fold. The Qalala-'Araba fold is equally bounded both to north and south by highly fractured areas, such as the one around the Monastery of St Paul, which has not yet been studied in detail.

The importance of faulting in connection with the origin of the Nile Valley has lately been emphasized by Prof. A. C. Lawson in his Faculty Research Lecture at the University of California in 1927. Unfortunately his most telling examples are precisely those which are connected with the remarkable Qena-Luxor fold, and cannot be taken to prove that the main Nile Valley is of rift origin. To establish this point it would be necessary to have strong evidence of faulting along the edge of the valley in the long reach between Nag' Hammadi and Wasta, and there is also no evidence of dislocations bordering the valley longitudinally in the Nubian sandstone area between Isna and Aswan.

Indeed, the observations so far made seem to indicate that transverse fractures across the Nile Valley are more frequent and significant than longitudinal faulting parallel with the valley.

The Tethyan type of folding may also have determined the remarkable S-shaped bend of the Nile in southern Egypt and the northern Sudan. The Nile begins its sharp north-eastward bend at the Second Cataract near Wadi Halfa, and only takes a northward turn some 250 km. downstream from the latter town. More detailed studies of the neighbouring deserts are required before this stretch of the Nile can be regarded as associated with a fold. In addition to these north-east and south-west folds there are some important fractures which cannot be fitted into any definite scheme. One of these is the Maghagha fault, a very marked fracture line trending north-west to south-east. Fault-lines of similar trend are present opposite El Fashn, and also in the Helwan and Ma'adi districts, as well as elsewhere in the northern areas of the eastern desert of Egypt. It is necessary to emphasize the point that there has been considerable disturbance in the limestone regions east of the Nile, the extent of which has still to be determined. Thus another important transverse fault-line is the one which, occurring to the north of Kom Ombo, is closely related to the development of the great plain near that locality, and to the well-known Silsila barrier. Its trend is slightly north of west and east of south.

Several very interesting domal structures are now known, rising abruptly from the relatively undisturbed surface of the Ma'aza plateau (the limestone desert area east of the Nile Valley and north of the Qena bend). In them the dip is markedly quaquaversal, but there is still much obscurity as to the reasons for these occurrences. One of these, Gebel Fahdi, is illustrated in Plate III of the writer's *Geology of Egypt*, vol. 1. It brings out clearly the sudden rise of this

conspicuous feature from the stony surface of the limestone plateau. The high ridge of Gebel Fertila, 46 km. south-east of Asyut, is another example, and is one of the points on the main geodetic triangulation net in the Nile Valley.

While it is relatively easy to determine the nature and extent of the fractures where these have affected rocks of varying colour and appearance, for instance, in those cases where white limestone and red granite or dark green schists are involved together in the dislocations, it is much more difficult to trace faults in the regions which are occupied by the unfossiliferous igneous and metamorphic rocks. Vast masses of igneous rocks of very varied composition have been intruded into a thick series of ancient sedimentary deposits in the eastern desert of Egypt and Sinai. This complex of metamorphic and igneous rocks (probably in the main of Archaean age) occupies an area of 93,000 sq. km., that is, well over one-third the area of Great Britain. There seems reason to believe that the foundation of the whole of this wide region is mainly granitic in composition. The schists and more basic igneous rocks are in a large number of instances often present as cappings on the underlying granite, mere relics of formations which were once the dominant surface features of the country. Erosion acting over a long period has been responsible for their disappearance. The diversity of the scenery in the hilly wilderness of the eastern desert of Egypt and Sinai is due to the complicated distribution of the various types of metamorphic and igneous rocks in this area, each of these having definite characteristics such as are described in my *Geology of Egypt*, vol. I. It is obviously very difficult to say, when granites and schists are in contact, whether the junction line is due to intrusion or to faulting. Only detailed mapping or comparison with the conditions in adjoining regions composed of sedimentary rocks might make it possible to determine the presence of dislocations where such associations occur.

6. *The Significance of Fracture and Folding in the Libyan Desert of Egypt*

The first impression left by a surface examination of the Libyan Desert is that of extraordinary simplicity and uniformity in the geological succession. This may, however, be to a certain extent misleading. For instance, the Mediterranean coast west of Alexandria by no means follows a regular curve, but there are at least three points at which it bends sharply from a west-north-westward to a north and south direction. Ras el Kenayis, Ras Alam el Rum, and Ras el Melh,

north of Sollum, are capes marking the northward termination of these bends. It is quite possible and even probable that these marked geographical features are the direct result of fracture, but no detailed geological study has yet been made of these areas. It had long been known that there were several important areas in the northern Libyan Desert below sea-level. But the extent and depth of these depressions had not been realized until the recent work of the Desert Survey gave them the prominence which they deserve. Dr Ball has already pointed out the significance of erosive agency in their formation, but a detailed stratigraphical study alone can determine whether they are in any way related to deeper-seated movements in the earth's crust.

The distribution of the main features of the Libyan Desert certainly leads to the conclusion that there is considerable complexity of structure in this varied and waterless region. For example, there is as yet no explanation why the Eocene and Cretaceous scarp which bounds Dakhla Oasis on the north, should turn so markedly at right angles in about longitude 31° E., and that the line of the Kharga Oasis itself should be a north–south one as compared with the east–west one of Dakhla Oasis.

As regards the origin of the Oases, it should be noted that all of these have evidently been formed by the more rapid denudation of alternating thin bands of sands and clays or fine marls as compared with the slower erosion of the homogeneous strata of limestone and sandstone which overlie and underlie them. This differential effect must have commenced as soon as these marine deposits were raised above the sea. Thus the Oases of Dakhla, Kharga, and Bahariya have been produced by the wearing away of the sands and marls of the Upper Cretaceous age, the Eocene limestone beds or Nubian sandstone forming the higher ground which encloses them. Similar denudation of the Ravine beds of the Middle Eocene has determined the low-lying Faiyum, bounded to the north by basalt-capped cliffs and to the south by the harder Nummulitic Gizehensis beds. In the same way a great series of sands and marls of Lower Miocene age has probably in the first instance given rise to the depression between Siwa and Moghara, the great extent and depth of which below sea-level has lately been indicated by Dr Ball. The present writer hesitates to pronounce in favour of a purely aeolian deepening below sea-level of this vast area and that of the Faiyum, in view of the evidence which is accumulating as to the relatively recent development of desert conditions in Egypt.

Detailed topographical and geological study of the vast area of the

Libyan Desert situated in Egypt is necessary before we can hope to explain the extent to which folding and fracture have been controlling factors in its development. The object of this short paper is to indicate that further study of the tectonics of the Egyptian desert promises to yield results of far-reaching interest and significance.

PROF. P. FOURMARIER: Je me fais un plaisir d'adresser de très vives félicitations à M. le Dr Hume qui apporte une très importante contribution à l'étude géologique et morphologique du Sinaï et de l'Égypte. Dans la description qu'il donne des dislocations affectant ces régions, je trouve l'analogue des grandes failles de l'Afrique centrale et l'analogue des plis et des failles de l'Afrique du Nord (Algérie et Tunisie). Le continent africain montre ainsi une grande unité dans son évolution. Je prie le Dr Hume de bien vouloir préciser l'âge des venues basaltiques alignées suivant la grande faille Est–Ouest qui coupe la péninsule du Sinaï.

PROF. GREGORY congratulated Dr Hume on the completion of the survey of the whole of Sinai, as that peninsula had at an early date attracted attention as one of the complex areas traversed by the Great Rift Valley. From Sinai we may expect the most precise evidence as to the history and structure of the complex areas together with the date of the earth movements. He asked if the N.E./S.W. folds were part of Krenkel's Syrian arc. That the N./S. part of the Lower Nile Valley was a rift valley had been suggested in Egypt in 1897, but in correspondence then he had urged that if it were a rift valley, it was one of a type fundamentally different from that of the Red Sea. If the N./S. trend of the Sollum series was not due to faults, its existence seemed difficult of explanation. Evidence in favour of faulting occurred in the Aegean and Cyrenaica.

DR HUME, in reply to Prof. Fourmarier, said that the basalts of the big fracture traversing North Central Sinai were probably of early Miocene age. In regard to Prof. Gregory's remarks, it is to be noted that there is a sharp difference between the two sides of a line formed by the Dead Sea–'Aqaba Rift and continued to the western shores of the Red Sea in Egypt near Quseir. To the left or north-west is the complicated fold and fault region of Sinai, the Clysmic area and the big fault areas between Quseir and Suez, near the shores of the Gulf of Suez. Southward of Quseir the disturbances along the boundary of the granitic-metamorphic rocks on the one hand and the sedimentary rocks (mainly Miocene to Recent) on the other consist in a somewhat steeply dipping—35° on an average—coral reef of Miocene age plastered against ancient Archaean formations. The precise mechanics of the origin of this structure still require explanation. Study of the north-west portion of Egypt has not advanced far enough for us to say what evidence it will give us in support of Krenkel's arc. A brief reference was made to the absence of any evidence of rift-formation in the Nile Valley between Isna and Aswan, the east side of which was walked over from end to end by the speaker.

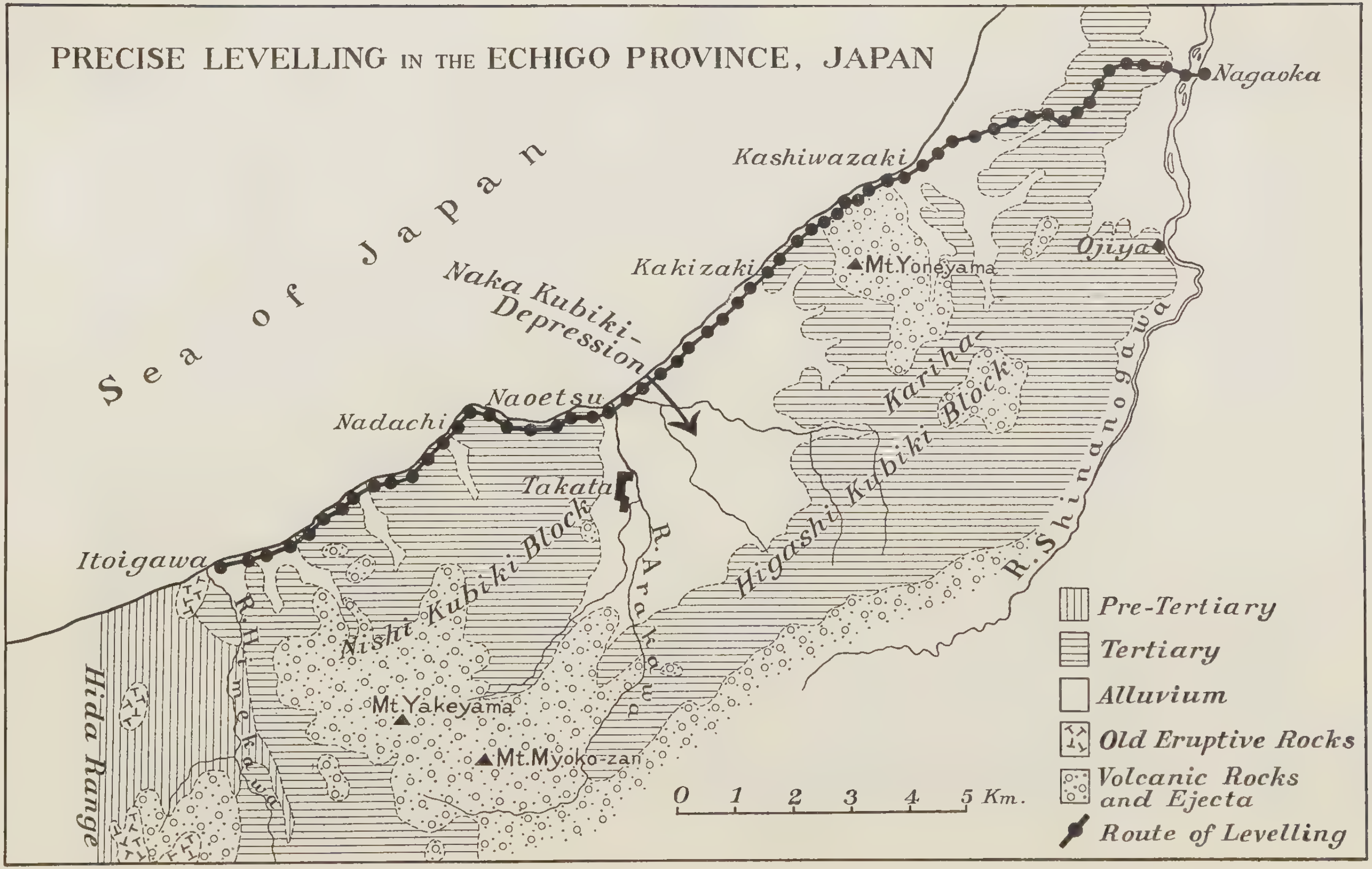
ACUTE AND CHRONIC TILTING OF LAND BLOCKS IN JAPAN

PROF. NAOMASA YAMASAKI

As the Japanese Islands stand on an unstable structure of the Pacific borders they have several similarities to the western coast of North America from the structural and physiographical points of view. They are traversed by numerous active faults and there are many tilted blocks bordered by those faults, which may naturally be called "active tilted blocks." The settling movements are often accompanied by earthquakes of various intensities. The great Kwanto earthquake of 1923 is one of the best examples of this movement. Very remarkable new faults were formed in this earthquake, not only along old fault-lines on the surface of the land, but also along the pre-existing deep trench in the sea floor of the Bay of Sagami, where the vertical displacement of the floor was found to be more than 200 m. in some places. Another example was observed in the great earthquake of 1927 in the Oku-Tango Peninsula, where two remarkable faults, with lengths of 18 km. and 7·5 km. were formed crosswise along old dislocation lines, with a vertical displacement of more than 1 m. In this case the peninsula did not move as a single block; but some blocks bordered by those faults underwent their own respective movements which accompanied the main and after shocks of the great earthquake.

Besides those acute tiltings which happen so instantaneously, there is another kind of tilting, which is of a chronic character and ascertainable only by repeated accurate levelling extended over a long period. During recent years the author has undertaken the determination of a tilting of this kind. The region selected for this purpose was the littoral province of Echigo on the coast of the Sea of Japan. As we may observe on the map[1], there is the lofty Hida range to the west of this district. It is the highest mountain range in the main island of Japan, with many peaks of over 3000 m. Hence it was called the "Japanese Alps" by the Rev. Walter Weston. It consists mostly of pre-Tertiary formations, old eruptive rocks, and is capped here and there with young volcanoes. This range makes a gigantic scarp to the east, and along its foot stretches the tectonic valley of the River Himekawa. Very sharply separated by this tectonic valley, the district to the east is quite different in its form and geology. It consists mostly

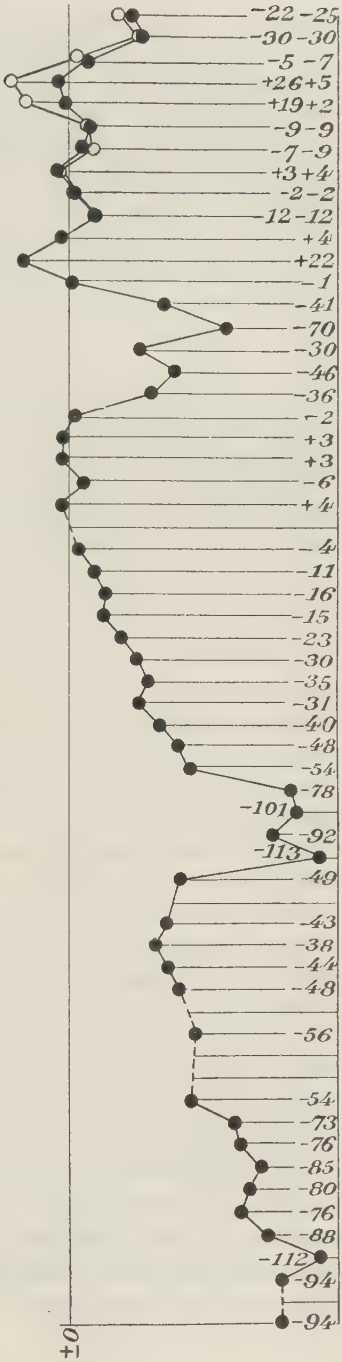
[1] See p. 218.



PRECISE LEVELLING IN THE ECHIGO PROVINCE, JAPAN
Sea of Japan
Nagaoka
Kashiwazaki
Kakizaki
Ojiya
Mt.Yoneyama
Naka Kubiki-Depression
Naoetsu
Nadachi
Takata
Itoigawa
Kariha Block
Higashi Kubiki Block
Nishi Kubiki Block
R. Shinanogawa
R. Arakawa
R. Himekawa
Mt.Yakeyama
Mt.Myoko-zan
Hida Range
0 1 2 3 4 5 Km.
Pre-Tertiary
Tertiary
Alluvium
Old Eruptive Rocks
Volcanic Rocks and Ejecta
Route of Levelling

of the hills of oil-bearing marine formation of the Tertiary period, through which younger volcanic rocks were erupted, making some prominent cones, as for example, Myoko-zan and Yaki-yama. These Tertiary hills are divided into two mountain blocks, which are separated from each other by an embayment of low plain. The Tertiary strata are well folded and are traversed by many fault-lines. The general trend of the strike is S.W.–N.E.

A precise levelling of this region was carried out for the first time in 1894. It was repeated last year by the request of the author, which was kindly accepted by the Land Survey of Japan. In comparing the results of the two levellings, it has been found that both of the mountain blocks have subsided since the previous levelling, the amount of the subsidence varying from 2 mm. to 113 mm. It is worthy of remark that in each of the mountain blocks the depression decreases as we proceed from west to east, until it reaches a minimum near the east end of each block, where it increases suddenly to a maximum, making a steep fall in the curve which shows the amount of depression. Thus the movement of each block has occurred in the same sense, making a tilting with its scarp side in the east and back slope to the west. These scarps coincide with the pre-existing faults. Thus these movements have been taking place for thirty-four years slowly and continuously and without any sudden disturbance of land form. The tilting is active, although chronic and not acute.



PROF. E. DE MARTONNE: Nous devons féliciter le Prof. Yamasaki pour son très intéressant exposé des phénomènes tectoniques du Japon. Il est permis en même temps d'exprimer un désir, que nos collègues japonais pourraient sans doute réaliser. Le plupart des failles qui sont connues en France, de même que dans la plupart de l'Europe, sont des failles anciennes, qui ont été nivelées; celles qui apparaissent dans la topographie ne doivent le plus souvent leur relief qu'à l'érosion différentielle. Il est probable que des failles rajeunies de ce genre existent au Japon; mais les failles récentes, résultant de mouvements tectoniques "actifs" paraissent réelles. Nos collègues nous rendraient un très grand service, s'ils pouvaient fixer les caractères topographiques caractérisant les failles récentes en les opposant à ceux des failles anciennes rajeunies par l'érosion. L'application de ces principes nous aiderait considérablement dans nos études morphologiques en Europe, ainsi que dans les pays peu exposés aux dislocations sismiques actuelles.

PROF. DOUGLAS JOHNSON said that in eastern North America a large proportion of the escarpments bordering faults appeared to be "fault-line scarps" produced by removal of weak beds from one side of the fault, and not true fault scarps due directly to displacement. He agreed with Prof. de Martonne that the geographers of Japan were doubtless in a position to make better comparisons between fault-scarp topography and fault-line-scarp topography due to erosion than were geographers of other countries where recent faulting had occurred only in limited degree. He congratulated the speaker both on the excellence of his paper and the interest of his field of investigation.

L'ORIENTATION DES DUNES CONTINENTALES

L. AUFRÈRE

Nous présentons dans cette communication et surtout à titre provisoire, les résultats acquis, ou entrevus, pendant la préparation d'un mémoire sur les dunes continentales de la Terre. Les études régionales et la cartographie des régions arides permettent d'essayer une synthèse et de s'en servir pour apporter des précisions à la circulation atmosphérique dans des régions souvent dépourvues d'observations météorologiques régulières. Nous étudierons seulement les formes majeures, les seules qui puissent être représentées sur les cartes au 1:1,000,000 ou à une échelle inférieure. Ce sont habituellement de longues chaînes de sable qui portent, dans le Sahara septentrional, le nom de *draa*, mot arabe qui signifie *bras*, et, dans l'Arabie intérieure, le nom de *flûk*. Entre les chaînes, les sillons interdunaires sont des *feidjs* quand ils sont ensablés et des *gassis* quand le plancher est à peu près libre de sable. Les feidjs et les gassis du Sahara septentrional correspondent à peu près aux *aftouts* de la Mauritanie, aux *omourambas* du Kalahari, aux *bajirs* de la Serinde et aux *ka'ars* de l'Arabie. Parfois les dépressions interdunaires sont jalonnées de mares qui les ont fait assimiler à des vallées fluviales. Les aftouts et les omourambas désignent parfois des vallées à fond humide et généralement dépourvues d'eau courante.

Hémisphère boréal

Dans les *régions tempérées* de l'hemisphère nord, les dunes continentales ont été étudiées avec beaucoup de soin en Hongrie, en Allemagne, en Pologne, en Suède, dans les Landes de Gascogne, et dans la province de Ségovie.

I. Högbom a résumé les principaux travaux relatifs à l'Europe centrale et septentrionale en y ajoutant d'importantes observations personnelles. Dans ces régions, les dunes semblent parallèles aux vents qui les ont formées; elles sont aujourd'hui fixées par la végétation et elles remontent à un passé aride que I. Högbom place dans le *finiglaciaire*.

Dans les Landes, en Allemagne, et en Pologne elles sont orientées à peu près Ouest-Est. Leur direction ne paraît pas différente de celle des vents dominants de la période actuelle dans ces régions qui se trouvent dans le domaine des "westerlies." Celles de Suède seraient des dunes sculptées dans des dépôts périglaciaires par un foehn descendu des Alpes scandinaves et dérivé des westerlies par une conversion vers la droite, c'est-à-dire vers le Sud.

Dans l'Asie centrale, les dunes prennent une extension considérable, et dans le Turkestan, les déserts de sable portent le nom de *koum*. Elles ont été décrites et levées avec beaucoup de précision par Sven Hedin, qui semble les considérer comme des dunes transversales. Il signale pourtant une différence angulaire importante entre la normale aux vents dominants et la direction des chaînes: "Si l'on considérait seulement les vents dominants, on serait tenté de dire que les chaînes de dunes et les dépressions (interdunaires) devraient nécessairement s'étendre du N.N.W. au S.S.E. car c'est de l'E.N.E. que viennent les vents dominants. Mais au lieu de former un angle droit avec la direction du vent, elles forment un angle aigu."

Dans le désert de Takla Makhan, au Sud du Tarim, les chaînes de sable sont orientées N.S. ou N.N.E.-S.S.W.; plus à l'Est, dans la région de Lou-lan, elles vont du Nord au Sud, puis du N.N.E. au S.S.W. pour se terminer avec une direction N.E.-S.W. (N. environ 50° E.). Dans la même région se trouvent des *yardangs* qui, d'après Stein, paraissent avoir la même orientation que les dunes: ils vont de l'E.N.E. à l'W.S.W. Sur les cartes de Sven Hedin, les yardangs ont la même direction que les dunes. Le sol du désert de Takla Makhan n'est pas toujours du sable: souvent, c'est une poussière qu'on a comparée à du loess et à laquelle le tassement et les pluies donnent une certaine cohésion. Reprise par le vent, cette poussière

forme des nuages qui obscurcissent perpétuellement l'horizon. Pour que les dunes se forment, il faut que les particules que le sol offre au vent soient trop lourdes pour flotter dans l'atmosphère, sinon les sillons creusés par la corrasion sont nettoyés par la déflation; ils restent toujours libres de sable et on a des yardangs.

Il semble qu'on puisse ramener à l'unité les intervalles interdunaires et les yardangs et les considérer au moins à l'origine, comme des *vallées éoliennes* creusées dans des milieux différents. La topographie acquise dépend du poids et du volume des particules que le sol présente au vent. Si le sable est trop lourd pour flotter dans l'atmosphère, il peut cependant être déplacé, par saltation, grâce au vent qui est susceptible de prendre une composante horizontale et une composante verticale. Les couches d'air assez éloignées du sol conservent une trajectoire plus rapprochée de l'horizontale et une vitesse qui n'est pas diminuée au même degré par le frottement. Elles ont alors une tendance à annuler les remous déterminés par les inégalités de la surface topographique et le sable tombe quand la composante verticale n'arrive plus à vaincre l'action de la pesanteur, et qu'elle atteint, en quelque sorte, son point mort. Ainsi, le vent emporte les poussières les plus fines dans l'atmosphère, il déplace les sables qu'il peut porter sur les crêtes respectées par la corrasion et il laisse en place les éléments les plus lourds qui forment les *regs* et les *serirs* du Nord-africain.

Les dunes peuvent être non seulement des formes de corrasion et de déflation comme les yardangs, mais aussi des formes de transport et d'accumulation. Leur évolution est susceptible d'une complication plus grande que celle des yardangs. Suivant le matériel dans lequel elles sont creusées, les vallées éoliennes, en vieillissant, peuvent présenter une différenciation qui les éloigne de plus en plus de leur unité originelle.

Les déserts chauds sont les plus étendus de la Terre et les dunes longitudinales y prennent une extension considérable. C'est l'examen des cartes du Sahara septentrional qui nous a conduit à chercher dans les alizés, la cause des grands alignements que présentent les dunes de la zone tropicale. Dans le Sahara atlésien, les chaînes de sable forment le Grand Erg Occidental et le Grand Erg Oriental; elles sont orientées N.W.–S.E. ou N.N.W.–S.S.E.; elles s'infléchissent vers le Sud dans le Sahara central et vers le S.W. et même l'W.S.W. dans le Sahara Soudanais. Dans l'ensemble, elles décrivent un immense arc de cercle ouvert à l'Est et conforme à la déviation qui paraît devoir être imposée à l'alizé par la rotation de la Terre. La trajectoire de l'alizé

continental, suggérée par la direction des dunes sahariennes, présente une courbure analogue à celle de l'alizé océanique sur le versant oriental et méridional de l'anticyclone des Açores où l'on passe des westerlies aux alizés par l'intermédiaire des vents de Nord-Ouest.

Les dunes sahariennes les plus septentrionales sont celles du Souf. Généralement fixées par la végétation, elles portent le nom de *chouchet* et, d'après Bourcart, elles sont dues au creusement des assises sableuses de la fin du Tertiaire. Le matériel qui les constitue paraît autochtone, et il présente à peu près la même composition que le substratum.

Dans cette région de transition entre les westerlies et les alizés, les directions des chaînes sont assez embrouillées. D'après le Chatelier, il y aurait deux directions principales, N. 15° W. et N. 30° E.; ce sont aussi celles qui sont relevées sur les cartes du Service Géographique de l'Armée. Mais d'après Bourcart, les dunes iraient aussi de l'Ouest à l'Est et Rolland a signalé, dans la région de Ouargla, des orientations W.N.W.–E.S.E. et N.W.–S.E. Parmi les composantes anémométriques, qui se sont inscrites sur les champs de sable du Souf, figurent sans doute des westerlies déviés vers le Sud, surtout pendant les mois d'hiver, et des alizés venant de la Méditerranée pendant l'été, les premiers soufflant sans doute sur le versant oriental des anticyclones mobiles venant des Açores. D'autre part, les directions ont dû être observées sur des dunes longitudinales et sur des dunes transversales et il faudrait que la distinction ait été faite pour tirer des conclusions météorologiques certaines.

La direction N.W.–S.E. est réalisée au Nord de l'Erg Occidental et de l'Erg Oriental. Des chaînes isolées se trouvent sur des plateaux pierreux; elles portent le nom de *slassel*, et, d'après Rolland, le sable qui les constitue vient du N.W. La conversion vers le Sud s'effectue parfois assez brusquement dans le Nord de l'Erg Occidental et de l'Erg Oriental pour suggérer une intersection, c'est-à-dire plusieurs composantes anémométriques et peut-être une discontinuité; elle est beaucoup plus régulière dans le Chach et dans l'Iguidi où les chaînes de sable s'infléchissent progressivement vers l'Ouest. Les parties les plus élevées des slassels et des draas portent le nom d'*oghroud*; Foureau et Chudeau semblent les considérer comme des collines ensablées. Le plancher rocheux est généralement visible dans les gassis. Il est habituellement composé de grès et de poudingues calcareux où le vent pouvait trouver du sable pour creuser des sillons et couvrir les crêtes dégagées par la corrasion. Le creusement par le vent concorde avec l'hypothèse de Foureau et de Chudeau, et la complète en l'expliquant. Il est possible que, sous le Tertiaire, la corrasion atteigne les

terrains anciens. Si le sable est autochtone, le creusement expliquerait l'apparition du dévonien et du carbonifère dans l'erg Issaouan et du substratum *saharidien* dans l'Iguidi et dans le Chach.

La conversion des chaînes vers le S.W., l'W.S.W. et même vers l'W. se produit dans les dunes du Sahara Soudanais. Les dunes mortes de l'Azouad et de la Mauritanie ont été décrites par Chudeau, qui les considérait comme des dunes longitudinales et les attribuait à l'action des vents d'W.N.W. (alizés). Les dunes littorales sont parallèles à la côte, mais les "formes de remaniement" présentent une orientation différente et des barchanes ont leurs ailes ouvertes vers le S.W. A Dakar, le sol est couvert de dunes anciennes fixées par la végétation pendant la saison des pluies, mais le sable se remet en marche pendant la saison sèche et se déplace vers le Sud (Hubert).

D'une façon générale, les dunes mortes de la Mauritanie, de l'Azouad et du Ténéré, ont une orientation qui se raccorde avec celles du Sahara central; elles ne sont pas absolument fixées et peuvent être soumises à des remaniements pendant la saison sèche comme celles de la région de Dakar. Cependant les explorateurs qui les ont parcourues les considèrent comme des dunes remontant à un passé plus aride que la période actuelle. Elles suggèrent pour les vents dominants de cette époque une trajectoire semblable à celle des vents qui soufflent aujourd'hui dans la même région. Le désert s'étendait davantage vers le Sud; les vents étaient plus secs, mais leur direction n'a pas varié. Il est possible que l'alizé *austral* qui pénètre dans ces régions avec des caractères de mousson était alors moins important ou moins humide, mais les éléments dynamiques de l'atmosphère de ce plus grand Sahara n'étaient pas extrêmement différents de ce qu'ils sont aujourd'hui.

Les dunes du Grand Erg Oriental et celles du Souf se trouvent dans un immense bassin tectonique comparable au Bassin d'Aquitaine. Les couches plongent vers le Nord jusqu'au piémont atlésien comme celles de l'Aquitaine jusque vers le piémont pyrénéen. Les dunes paraissent sculptées dans les dépôts les plus récents ou construites avec du sable qui leur a été emprunté. Ces couches se trouvent dans la partie la plus basse de la cuvette, quand elle n'est pas sous les eaux des *chotts* constantino-tunisiens. L'Erg Occidental est à l'Ouest de la cuesta du Mzab, et sa bordure orientale se trouve sur une dépression monoclinale ou périclinale. Là encore, les dunes peuvent avoir été construites comme celles de l'Erg Oriental, aux dépens des couches accumulées par un passé endoréique, néogène ou quaternaire. Les ergs d'Issaouan et d'Edeyen paraissent occuper la même position

vis-à-vis de la cuesta de Tinguert que l'Erg Occidental à l'égard de la cuesta du Mzab et les vallées éoliennes ont dû atteindre les terrains primaires après avoir traversé les dépôts continentaux oligo(?)-miocènes, pliocènes ou pléistocènes. Gautier a antérieurement attribué le matériel des dunes aux sables tertiaires ou quaternaires.

Les dunes du Sahara Occidental semblent avoir été modelées surtout par l'alizé continental dans les dépôts endoréiques accumulés dans les dépressions d'une surface topographique antérieures à l'Oligo(?)-Miocène. Cette surface topographique elle-même qui paraît à peu près libre de dépôts continentaux éogènes doit être l'œuvre d'un passé "exoréique" où les cours d'eau venus du Sud se jetaient dans la mer qui se trouvait sur l'emplacement actuel de l'Atlas. Les dépôts continentaux tertiaires ou quaternaires ont dû être soumis à des phases d'érosion éolienne et d'érosion fluviale suivant les oscillations subies par le climat.

Les directions des dunes du Grand Erg Oriental sont Nord–Sud à l'Ouest, et les gassis sont extrêmement larges. Leur direction est aussi celle des oueds conséquents qui viennent du Tademaït de sorte que les grands gassis, semés de cailloux roulés, pourraient être des vallées conséquentes sculptées pendant un passé humide et élargies par l'alizé du Nord. Dans le centre de l'erg on trouve deux directions, l'une Nord–Sud, l'autre N.W.–S.E. Le gassi Touil peut très bien correspondre à la vallée de l'Igharghar élargie par les vents du Nord. A son Est, se trouvent des chaînes orientées N.W.–S.E. qui découpent obliquement le versant oriental du gassi. L'Est de l'erg est beaucoup plus confus; les directions sont plus nombreuses comme si la composante principale n'était pas nettement établie. On y a signalé la direction N.W.–S.E. qui est aussi celle des vallées conséquentes de la bordure orientale. Il est possible que l'enchevêtrement des sillons interdunaires représente un complexe où figurent des vallées fluviales et des vallées éoliennes et aussi des dunes transversales. Des périodes humides postérieures à l'Oligo(?)-Miocène ont d'ailleurs laissé des coquilles que le vent a parfois porté jusque sur le sommet des oghrouds et une enveloppe limoniteuse autour des grains de sable. Les traces d'un ancien sol et l'existence d'une faune et d'une flore résiduelles dans les parties les moins desséchées du Sahara apportent la preuve de plusieurs oscillations climatiques dont on doit tenir compte dans l'explication morphogénique des ergs sahariens.

Dans le Désert Libyque, la "mer de sable" est peut-être formée parfois de collines disposées sans ordre, mais plus souvent de chaînes parallèles qui ont paru à Mrs Rosita Forbes orientées à peu près

Nord–Sud. A l'Est se trouvent de nombreuses chaînes détachées comparables aux slassels du Sahara atlésien. Leur orientation est N.N.W.–S.S.E. au Nord. Dans la partie méridionale du désert, elle s'infléchit vers le Sud-Ouest à l'Ouest, mais elle reste N.N.W.–S.S.E. à l'Est. Ces chaînes atteignent parfois une longueur considérable; elles n'existent pas au Nord de la *cuesta désertique* formée de calcaires vindoboniens. Elles partent de la dépression monoclinale de Moghara-Qattara-Sirva, excavée par le vent dans les sables burdigaliens. Poussées par les vents du Nord, elles s'allongent vers le Sud et cheminent souvent sur des plateaux rocheux, constitués par l'Éocène ou le Crétacé. Elles se décomposent parfois en barchanes dont les ailes sont ouvertes vers le Sud. Ici les chaînes ne sont pas des formes de creusement, mais des formes d'accumulation et de transport.

La conversion des chaînes vers le Sud-Ouest ne se produit plus dans le Sud du Désert Libyque, à l'Est du 26° parallèle, dans les régions explorées par le Prince Kemal el Din où les dunes les plus méridionales ont une direction subméridienne. Tout se passe comme si la déviation normale de l'alizé vers l'Ouest n'existait pas dans la partie orientale des déserts égyptiens. D'après des observations météorologiques régulières, dans la région de Khartoum, les vents dominants viennent du Nord. Par contre, la déviation à l'Ouest se retrouve dans les régions tchadiennes, après la solution de continuité introduite dans les déserts de sable par les steppes d'altitude du Tibesti et de l'Ennedi. Elle est conforme à la direction des vents dominants observés à la station de Bol, sur la rive orientale du Tchad, surtout pendant la saison sèche.

Dans ces régions, un fait important a été observé par Audoin et confirmé par Garde. Le Tchad et les lacs desséchés qui sont au Nord se sont installés sur des dunes anciennes qui présentent une orientation différente des dunes actuelles. Les chaînes de sable et les intervalles interdunaires vont du N.N.W. au S.S.E. Cette disposition suggère une trajectoire des vents dominants presque perpendiculaire à celle qu'on observe aujourd'hui dans les mêmes régions. On ne la retrouve que dans le Sahara méditerranéen; sa présence, à une époque ancienne, antérieure aux extensions lacustres "paléotchadiennes" et aux périodes humides qui les ont provoquées, pourrait s'expliquer par une modification importante dans la position ou dans l'extension des grands centres d'action de l'atmosphère, soit par une contraction de la zone des basses pressions équatoriales, soit par un glissement vers le Sud des anticyclones subtropicaux de l'hémisphère nord par rapport au continent africain.

La présence des dunes fossiles parfois submergées implique d'ailleurs d'importantes modifications climatiques et des conditions géographiques très différentes des conditions actuelles. Ces dunes sont non seulement antérieures au Tchad et aux extensions lacustres paléotchadiennes mais aussi au réseau hydrographique du centre africain. Ou le Chari, le Logoune et la Komadougou n'existaient pas, ou leurs eaux n'allaient pas dans les régions où elles se réunissent aujourd'hui. Les dunes fossiles paraissent tranchées par la vallée du Bahr el Ghazal et sont certainement plus anciennes que lui. Ces changements considérables survenus depuis la formation des dunes anciennes permettent, semble-t-il, de faire intervenir une modification des centres d'action capable de donner lieu à des vents venant du Nord ou du N.N.E. Cependant, il faudrait des observations directes sur le terrain pour écarter définitivement l'hypothèse des dunes transversales qui est beaucoup plus simple puisqu'elle n'exige pas de modifications importantes dans l'économie générale de la circulation atmosphérique. Les dunes actuelles qui ont été signalées dans ces régions sont surtout des formes de remaniement de l'ancien système dunaire et elles s'orientent d'ailleurs conformément aux vents dominants de la saison sèche, c'est-à-dire à l'alizé qui souffle du N.E. ou de l'E.N.E.

A l'Est du Canal de Suez, l'orientation des chaînes de sable est conforme à la direction des vents dominants qui viennent du N.W. ou du N.N.W., bien que les vents porteurs de sable viendraient peut-être de l'Ouest et du Sud-Ouest. Le versant le plus raide est à l'Est, du côté du vent qui apporte les sables. Cette dissymétrie des dunes longitudinales est à rapprocher de celle qui a été signalée dans le Sahara par Chudeau; par endroits, elle se déplace avec les saisons; elle paraît due aux composantes secondaires alors que la direction des chaînes doit, selon nous, être attribuée à la composante principale. Les ergs de l'Arabie portent le nom de *nehfoud* ou de *dahna*. Le dunes du Grand Nehfoud sont généralement des dunes longitudinales, elliptiques; elles portent le nom de *flûk*; les parties les plus élevées, comparables aux oghrouds sahariens, sont des *tu'us* ou des *barahis*; dans les intervalles interdunaires, la partie la plus profonde, généralement libre de sable, porte le nom de *farse* et la partie la plus élevée est couverte de dunes plates ou *nawazi*. Au Nord, la direction des chaînes paraît W.–E. et N.W.–S.E.; dans le Dahna, elle s'infléchit vers le S.S.E., et cette orientation se retrouve à quelque distance de la côte orientale, à l'Ouest de Bahrein. La conversion est encore moins complète que dans l'Est des déserts égyptiens. D'après les cartes au

1/M, la direction passerait au S.E. dans l'Arabie méridionale. Dans l'Est du Grand Plateau désertique, l'alizé paraît dévié vers l'Est, sous l'influence des basses pressions qui se tiennent en hiver au-dessus de l'Océan Indien et en été au-dessus de l'Asie centrale. La trajectoire suggérée par l'orientation des chaînes de sable concorde avec celle des vents dominants qui soufflent au-dessus de la Mer Rouge et du Golfe Persique.

Dans les régions arides et semi-arides du Bas-Indus on passe *aux dunes de mousson* qui ont été étudiées par les géologues anglais. Au Nord du Rann de Cutch, des dunes longitudinales s'étendent du Sud-Ouest au Nord-Est, mais à l'intérieur du continent on a des dunes en *rateau* dont les dents conservent l'orientation précédente, mais la barre est perpendiculaire à la direction générale. Plus loin vers le Nord, les dents disparaissent, la barre subsiste seule; les dunes longitudinales ont fait place à des dunes transversales qui se réalisent lorsque la mousson d'été et la mousson d'hiver se font équilibre.

Hémisphère austral

Mais si nous voulons retrouver dans l'hémisphère austral une disposition symétrique de celle de l'hémisphère boréal, il faut évidemment faire abstraction des dunes de mousson et chercher seulement les directions homologues de celles du "Grand Plateau désertique." Nous laissons de côté le Nouveau Monde où les dunes sont moins importantes et moins connues, comme nous l'avons fait pour l'hémisphère boréal.

Nous n'aurons pas à nous occuper de la zone tempérée qui est extrêmement réduite dans l'Afrique du Sud et dans l'Australie. Les steppes du Kalahari sont trop arrosées pour que les dunes mouvantes aient une importance comparable à celles des déserts du Nord de l'Ancien Monde. Les sables du Kalahari présentent des ondulations allongées que les géologues allemands nomment des *Sandwellen* et sur le caractère desquelles les opinions sont parfois indécises. Les intervalles qui les séparent sont souvent assimilés à des vallées au fond humide et généralement dépourvues d'eau courante. Ils portent le nom d'*omouramba* et certains d'entre eux sont comparables aux oueds nord-africains. Il semble bien cependant que le parallélisme des Sandwellen permette d'y reconnaître des dunes longitudinales anciennes battues, émoussées ou aplaties par les pluies depuis la période sèche pendant laquelle elles se sont constituées. Peut-être faut-il reconnaître des dunes mouvantes dans les chaînes de sable indiquées sur les cartes à grande échelle, dans les demi-déserts de l'Orange et du

Kalahari méridional. Elles semblent s'aligner du S.S.E. au N.N.W. et présenter une orientation symétrique de celles du Sahara sous des latitudes correspondantes. Dans les régions qu'il a parcourues, Passarge a trouvé quelques Sandwellen orientées à peu près W.N.W., mais ces formes ont surtout été signalées dans les régions de l'Ouest et du Nord.

Au Nord-Est, dans le Baroutsé, elles sont orientées du S.E. au N.W. tandis qu'à l'Ouest, leur direction est à peu près E.–W., dans le Namaland, dans l'Ovamboland et dans les champs de sable compris entre le Kounene et le Koubango. La déviation vers l'Ouest est complète dans le Kalahari occidental et dans les Hautes Terres du désert des Diamants. On sait que dans le Sud-Ouest africain, la composante principale de la rose anémométrique se rapproche de l'Est. Ces dispositions changent dans le désert littoral. Au-dessus du courant de Benguella, l'alizé souffle à peu près du Sud au Nord. Aussi, dans le Namib, les formes de déflation prennent-elles une orientation subméridienne, comme la brise de mer qui paraît d'ailleurs fortement déviée par l'alizé.

Les régions dunaires présentent une extension considérable en Australie qui est le Grand Plateau désertique de l'hémisphère austral. Les régions les plus sèches ne sont pourtant que des déserts atténués comparables à ceux de l'Arabie. Entre la Cordillère et les Hautes Terres de l'Ouest, les ergs alternent avec des plateaux désertiques ou subdésertiques. Elles prennent une extension considérable dans les déserts intérieurs de l'Ouest, désert de Warburton, désert de Gibson et désert de Victoria. Elles ont été décrites par Gregory et se présentent sous forme de chaînes régulières allant de Ouest-1/4 Nord à Est-1/4 Sud. C'est la direction des vents qui, d'après Taylor, soufflent d'une façon à peu près permanente dans ces régions. Comme dans l'hémisphère nord, c'est l'alizé qui détermine l'alignement des chaînes et qui pousse le sable au-dessus de l'océan quand les dunes continentales viennent jusqu'à la mer. C'est ce qui se passe sur la plage des Quatre-vingt-dix milles ("Ninety Mile Beach"); le sable se déplace dans le sens des chaînes; il est sans doute emprunté aux formations continentales accumulées pendant les époques humides antérieures; il a été modelé par le vent, peut-être surtout dans un passé plus sec que la période actuelle. Aujourd'hui les dunes de l'Australie tropicale sont généralement peu élevées et couvertes de végétation.

Dans le Grand Bassin intérieur, les dunes longitudinales se retrouvent dans l'Arunta avec la direction N.W.–S.E., qui est encore celle de l'alizé. On trouve bien sur certaines éditions du Stielers

Handatlas des directions aberrantes difficiles à expliquer. Parfois sous le même parallèle, la direction change avec les limites administratives. On emploie parfois, dans la cartographie, une figuration conventionnelle qui peut donner l'idée d'une direction en désaccord avec les autres cartes et les descriptions des explorateurs[1].

Les considérations précédentes auront besoin d'être précisées et peut-être modifiées; des problèmes importants ont été seulement indiqués ou annoncés; d'autres n'ont pas même été abordés et ne pouvaient pas l'être dans un exposé forcément limité par les convenances et les règlements dans un Congrès international. On peut néanmoins dégager les conclusions ou les propositions suivantes:

(1) Les grandes dunes continentales sont généralement des chaînes de sable orientées dans le sens des vents dominants.

(2) Les intervalles interdunaires peuvent être des sillons creusés par le vent, comme les yardangs; dans ceux-ci, le matériel libéré par la corrasion est porté par l'atmosphère jusqu'à ce que les pluies ramènent les poussières à la surface du sol. Dans les dunes, le matériel libre ou libéré par la corrasion est déplacé par le vent en rasant le sol jusqu'à ce que la force du vent soit inférieure à la pesanteur. Le sable peut se déposer à une très faible distance du point de départ ou par déplacements successifs être porté sur un substratum rocheux plus ou moins éloigné. Identiques à l'origine, les dunes et les yardangs se différencient suivant le matériel que le sol présente au vent.

(3) Les chaînes de sable sont des enregistreurs anémométriques qui doivent en général indiquer la direction des vents dominants, dans des régions qui sont souvent dépourvues d'observations régulières. La Morphologie terrestre offre ici à la Météorologie et même à la Paléoclimatique un moyen d'investigation qui peut être utilisé pour des contrées qui sont parmi les moins connues de la Terre.

(4) Pour arriver à des résultats à peu près sûrs, il faudrait que les explorateurs indiquent des directions aussi précises que possible. Celles des points cardinaux et des points collatéraux sont nettement insuffisantes. Les mesures en dégrés seules peuvent être considérées comme satisfaisantes. Mais il faudrait surtout éviter d'indiquer des directions quand on ne les connaît pas. Nous souhaitons qu'on emploie sur toutes les cartes un pointillé en quinconce ou en échiquier pour les dunes dont on ne connaît pas la disposition et qu'on réserve

[1] Les ensembles cartographiques les plus précieux pour l'étude des dunes des déserts sont les cartes au 1 : 1,000,000 et au 1 : 500,000 du Sahara par le Service Géographique de l'Armée Française, les cartes du N.W. de l'Inde par le Survey of India à une échelle voisine du 1 : 200,000, et celles de l'Égypte au 1 : 500,000 par le Survey of Egypt.

les traits à celles dont l'orientation a été levée sur le terrain. Sur les nouvelles cartes du Sahara, le Service Géographique de l'Armée Française est arrivé à une expression très satisfaisante.

(5) Dans les déserts tropicaux, les chaînes de sable s'ordonnent à peu près symétriquement, au Nord et au Sud de l'Équateur. Elles ont une tendance à présenter des courbes concaves vers l'Ouest, vers le Sud-Ouest dans l'Hémisphère boréal et vers le Nord-Ouest dans l'Hémisphère austral. Cette disposition est celle de l'alizé qui est le vent des déserts tropicaux et qui paraît aussi important et aussi régulier sur les continents que sur les océans.

(6) Il semble que sur les continents le passage des westerlies aux alizés s'effectue par des directions intermédiaires comme sur le versant oriental des anticyclones océaniques de la zone subtropicale. C'est sans doute sur les pentes *orientales* des anticyclones que s'effectuent les "décharges" d'air polaire dans la zone tropicale alors que l'air tropical paraît susceptible de pénétrer dans la zone tempérée en suivant le versant *occidental* des anticyclones.

M. CHAPUT note que dans les dunes de Gascogne, étudiées par Harlé avec une très grande précision, les dunes longitudinales sont des formes de destruction tandis que les dunes nouvellement construites sont transversales. Les dunes étudiées dans les déserts par M. Aufrère sont sans doute plus spécialement les dunes de destruction.

THE GEOGRAPHICAL DISTRIBUTION OF THERMIC ASYMMETRY

PROF. E. ROMER and S. ALBERT

[*Read by* Prof. E. Romer]

Abstract

Studies undertaken for a graphic demonstration of climate turned my attention to a certain climatic element, hitherto overlooked. I refer to the asymmetry in annual curves of temperature. I have expressed it by the difference of the sum of temperature in the five months before the solar culmination, and those following it.

$$As = \Sigma t_{\text{II–VI}} - \Sigma t_{\text{VIII–XII}}.$$

For the southern hemisphere and for the tropical zone it would be necessary to make allowance for the varying termini of the solar culmination.

It was possible to assume in advance that the value of this asymmetry would be always negative. This is not the case, however—the

areas of negative asymmetry, *i.e.* of delayed curve of temperature, are hardly greater than those of positive asymmetry.

On the basis of the material contained in *Réseau Mondial* I constructed a World Map of *Thermic Asymmetry*.

A study of the isasymmetric lines, drawn for every 10°, gave the following results. The southern continents are remarkable for their simplicity. Their interiors have a positive asymmetry of striking regularity, scarcely exceeding + 10°, while the coasts are followed by a negative asymmetry, everywhere betraying the influence of the sea, and this without the slightest regard to latitude.

In the sub-tropical zone of winter rains we distinguish a wide area of a high negative asymmetry of about, and even exceeding, – 20°. This area extends from the Azores to the Persian plateau.

The south and south-east extremities of South Africa and Australia afford a complete analogy to the above.

North of the Mediterranean zone we are struck by the negative asymmetry over vast continental stretches, apparently regardless of distance or even of the influence of the sea. The whole of Europe and Western Siberia and the whole of North America form an uninterrupted area of negative asymmetry, of a moderate character, not exceeding – 10°.

A remarkable feature in the geographical distribution of thermic asymmetry is that this asymmetry attains its negative maximum not on the west, the classic oceanic region, but on the east coasts, as well of North America as of Eurasia.

This phenomenon becomes exceedingly complex through the simultaneous appearance, within the Indian monsoon area, of the highest positive asymmetry in the immediate vicinity of the negative maximum of asymmetry.

The contrast between the development of thermic asymmetry in Japan, and that of India, precludes any attempt to explain the positive asymmetry of India as the result of deformation caused by the summer monsoon in the temperature curve. Moreover there are other facts and circumstances contradicting such an assumption. Negative asymmetry appears regularly with high values throughout Japan in the months of March, April, May and June. On the other hand, the Japanese monsoon rain season varies considerably with the different regions. In India this is not the case: here the asymmetry, positive throughout, attains high values in very different months. The months with maxima of asymmetry are in Calcutta: February, March, April; Allahabad: March, April, May; Jacobabad: March, April, May, June.

But the monsoon sets in precisely after the cessation of high values of positive asymmetry: in May (Calcutta), June (Allahabad), or July (Jacobabad).

From the above it will be seen that the monsoon of Japan is *independent* of the course of negative asymmetry, and, while the development of the India monsoon is *dependent*, it is hindered by positive asymmetry.

Not only the Indian front, but also the whole of Central Asia is surrounded by a broad zone of positive asymmetry, especially developed in the months of February and March, that is to say, in a period when winter is still very severe, but it is just in this season that the barometric gradient is the greatest. It is under these circumstances that round the Asiatic barometric maximum air currents descend. Intensified by the morphological conditions of Central Asia, they transform themselves into more or less typical Föhn winds, the most typical being naturally those that originate from the passage over the Himalayas.

In North America, where barometric conditions analogous to those of Asia are developed, the totally different morphological conditions exclude the development of analogous Föhn phenomena. But within the west and south periphery of the North American barometric maximum we find everywhere, in spite of the general negative asymmetry, positive values in February and March, the period of the highest barometric gradient.

In contrast to the weakly-developed positive asymmetry we find in the east and north-east area of the American maximum a vast region of powerful negative asymmetry, fully equalling that of East Asia. Hence the assumption that the negative asymmetry of the eastern regions of the continents is not closely connected with barometric conditions, but is rather the result of the marine circulation (cold currents) encouraged by barometric conditions.

PROF. DE MARTONNE: La carte du Prof. Romer ne présente que deux régions de forte anomalie—l'Inde et le Japon. Toutes les deux sont des régions de mousson. Il semble donc qu'il s'agit d'un phénomène bien connu: la fin de la période sèche est dans le pays de mousson hypercontinentale, aussi est-il naturel qu'elle soit le moment le plus chaud dans les basses latitudes, et qu'elle soit relativement trop froide dans les hautes latitudes.

PROF. E. BÉNÉVENT: (1) Les phénomènes d'asymétrie thermique négative dans la région méditerranéenne s'expliquent simplement par le retard que subit l'arrivée du maximum de température de la masse marine. Dans les Alpes françaises par exemple les automnes sont de plus en chauds relativement au printemps à mesure qu'on se rapproche de la Méditerranée. (2) Je n'ai pas entendu parler de l'influence de l'altitude sur l'asymétrie thermique:

j'ajouterai donc pour mon compte, que l'altitude agit dans le même sens que la mer pour retarder l'arrivée du maximum de température; que, par conséquent, elle tend à maintenir dans les régions éloignées de la mer l'asymétrie thermique négative dont parle le Prof. Romer.

PROF. ROMER said in reply that he thought the objections were due to his having been unable through shortness of time to present the problem as fully and as precisely as he would have wished. Thermic asymmetry, as distinguished from amplitude of annual temperature, is *quite independent of latitude*, and shows a striking contrast of values for the coastal and interior regions of every continent. Moreover, it brings out other features which are useful for climatic "regionalization." For example, the distribution of high values of negative asymmetry *shows very clearly the regions of winter rains* and the highest values of asymmetry demonstrate *two distinct types of monsoon region*—the Eastern (Asiatic and American), with maximum of *negative* asymmetry, and the Indian, with maximum of *positive* asymmetry. This second type of monsoon climate is to be explained by the fact that the system of winter atmospheric circulation has a distinct vertical component in the Indian monsoon region, and has consequently the character of a "Föhn."

Study of the distribution of thermic asymmetry during consecutive months shows that analogous vertical movement will be developed during special periods on the south and west sides of every winter maximum of barometric pressure and reveals special features which open up interesting possibilities for research.

24 JULY

LE MAËLSTRÖM

PROF. G. PARMENTIER

See *Bulletin de la Société de Géographie de Lille*, 1913, LIX, pp. 152–8, from which the following Résumé is an extract.

See also *L'Illustration*, LXXXVII (1929), pp. 748–9.

Résumé

Le Maëlström est un fort courant qui passe entre le rocher de Mosken, près de l'île de Verö, au sud des îles Lofoten, et l'extrémité de l'île de Moskenes (Lofotodden) par 67° 20′ latitude nord et 9° 20′ longitude est. La pointe des Lofoten ou Lofotodden termine l'île de Moskenes, d'où le nom de Moskenström par lequel les Norvégiens désignent communément le Maëlström.

Maëlström est un mot descriptif—celui que les poètes et les marins ont popularisé: il signifie "le courant qui moud."

Il existe dans le monde d'autres courants redoutables. La Norvège en compte plusieurs, notamment le Saltström, près de Bodö. Un grand nombre de détroits situés entre les îles resserrées des Vesteraalen, impraticables à la navigation, ont également reçu le nom caractéristique de Ström, ou courants. Mais le Maëlström a de tout temps été considéré comme le plus dangereux et le moins accessible. Une sorte de mystère l'enveloppe encore. Il appartient à la légende. Les marins

superstitieux n'osent l'appeler par son nom: ils disent "le nombril de l'Océan," persuadés que l'eau s'y engouffre dans un abîme traversant le globe.

Il suffit cependant de regarder une carte pour trouver l'explication naturelle de ce fabuleux phénomène.

Les eaux de l'Océan Glacial n'ont d'autre issue pour s'écouler vers la côte de Norvège que l'étroit couloir du Tjeldsund, situé entre l'île de Hindö (Vesteraalen) et celle de Tjeldö, séparée de la terre ferme par un autre détroit encore plus resserré que le précédent.

Arrivées dans le Vestfjord, les eaux se divisent en deux courants: l'un suivant la côte et aboutissant au Saltström, à peu près en face du Maëlström, l'autre longeant la côte orientale des Lofoten. Ce dernier courant contourne l'extrémité de Moskenes, la grande île du sud des Lofoten. Là, il se trouve aux prises avec les marées océaniques et forme, en passant autour d'une foule de récifs à fleur d'eau—la profondeur du Maëlström ne dépasse pas 60 m.—un tourbillon dont le centre est le rocher de Svarvene, près de celui de Mosken. Lorsqu'à cette lutte vient se joindre une tempête du nord-ouest, les eaux affectent un mouvement giratoire d'une vitesse inouïe, se creusent en entonnoirs, attirent à elles non seulement les barques de pêche, mais encore les navires de gros tonnage, les absorbent pour ainsi dire, les brisent sur les pointes des rochers et les rejettent à la côte. Le Maëlström est bien, selon son étymologie (*millstream*), "le courant du moulin, le courant qui moud."

Dans le court intervalle qui sépare le flux du reflux, cette fureur de destruction s'apaise: le courant reprend sa course normale vers l'est, à une vitesse moyenne de 30 km. à l'heure. Il est alors possible de le franchir, du moins en été, et à la condition de choisir l'heure propice et d'éviter les sautes de vent si fréquentes dans ces parages.

ABRASION PLATFORMS ALONG THE PACIFIC COAST OF JAPAN

G. IMAMURA

Abstract

In the present state of things in Japan, it is only in the case of shore-lines of emergence that we can find the exact amounts of displacements affecting the coastal topography. Among the many kinds of elevated coasts, the abrasion platforms are most suitable because of their almost perfect preservation of the former shore-line. These are

confined to the outermost parts of the peninsulas and, geologically speaking, are rather young in their origin; but whether or not their present positions are determined by the so-called eustatic change of level remains for closer investigation. To answer this question, three elements are here considered: namely, vertical displacement, horizontal displacement, and the distance from point or axis of stability.

A correlation of very high degree is found between the first and second elements. The coefficients of correlation are $0{\cdot}93 \pm 0{\cdot}026$ (Kitakami), $0{\cdot}81 \pm 0{\cdot}038$ (Yaku Shima), and $0{\cdot}86 \pm 0{\cdot}027$ (Atlantic coast of North America). This is direct evidence of the absence of eustatic movement along the Japanese coast because, if the vertical displacements be the same everywhere, so must also be the horizontal displacements, a fact which is quite absurd in the light of the data collected.

In the second place, we are unable to utilize the foregoing method in studying the relation between the third element and the other two, but in certain special cases we may be able to form a definite conclusion. Mention may be made of the following two:

(1) Two points of stability are given, and the axis of stability may be presumed as a straight line.

(2) All the points on an elevated shore-line are so arranged that they may be considered practically to form a rectilinear line.

In such special cases, it may be safely said that the first and the third elements are not proportional to each other, nor are the second and the third, that is to say, the earth's crust was deformed not as a rigid, but as a plastic body. If we differentiate these curves, this relation will become more and more clear.

In conclusion, we may say that the present distribution of the former shore-line along the Japanese coast was not determined by eustatic movement; that the crustal deformation which gave the old shore-line its present situation, was a kind of transverse folding and faulting; and finally, that in many cases the crust behaved not as a rigid, but as a plastic substance.

PROF. J. E. CHAPUT: Il apparaît clairement que des régions telles que le Japon, où existe certainement un soubassement plastique à faible profondeur par suite de l'extension du volcanisme, ne peuvent montrer actuellement des lignes de rivage parallèles au niveau de la mer, et que les observations y sont tout naturellement contraires à l'idée de mouvements exclusivement eustatiques. Il ne pourrait s'agir que de la possibilité d'une combinaison de mouvements tectoniques certains, en partie liés au volcanisme, et de mouvements eustatiques, d'ailleurs inconnus jusqu'à présent.

L'ORIGINE DU RÉSEAU HYDROGRAPHIQUE DU CONGO

PROF. P. FOURMARIER

Le réseau hydrographique du Congo présente à première vue une disposition singulière dont il peut être intéressant de chercher l'origine.

A. *Description Sommaire du Réseau*

(1) Le trait le plus marquant est le fleuve lui-même. Descendant de la crête séparative des bassins Congo-Zambèze, sous le nom de Lualaba, il coule, en allure générale, du Sud vers le Nord; c'est aussi l'orientation moyenne des affluents principaux de son cours supérieur, la Lufira et la Luvua. A partir de Stanleyville, le fleuve oblique brusquement vers l'Ouest, décrit une grande courbe qui le fait ensuite revenir vers le Sud jusque près du Stanley Pool; enfin, le cours inférieur, à la traversée de la chaîne côtière des Monts de Cristal, est dirigé Est-Nord-Est–Ouest-Sud-Ouest, c'est-à-dire à peu près perpendiculairement au rivage de l'Océan Atlantique.

(2) Les affluents de droite du Congo, en aval du confluent de la Luvua et jusque l'Itimbiri, descendent des hauteurs voisines de la ligne des grands lacs et, coulant vers l'Ouest, vont se jeter dans le fleuve à peu près à angle droit. En aval de l'Itimbiri, le principal affluent de la rive droite, l'Ubangi-Uele, montre une courbure dans le même sens que celle du Congo, encore plus exagérée cependant. Au delà du confluent de l'Ubangi, les affluents de droite tendent à s'orienter normalement au fleuve et il en est de même des rivières qui se jettent dans l'Ubangi lorsqu'il coule du Nord vers le Sud.

(3) A l'intérieur de la grande courbe du Congo, on peut distinguer deux parties nettement différentes quant à l'orientation des rivières.

(*a*) La partie méridionale, où tous les cours d'eau descendant de la crête Congo-Zambèze, ont une direction sensiblement méridienne; leurs eaux sont recueillies par une sorte de long chenal orienté à peu près suivant le parallèle et comprenant le Lubefu, le Sankuru et le Kasai inférieur. Un seul de ces cours d'eau fait exception : le Lomami; descendant également des hauteurs du Sud, il dépasse vers le Nord la ligne Lubefu-Kasai et va se jeter dans le Congo en aval de Stanleyville.

(*b*) La partie septentrionale est comprise entre le Congo, le Lomami et le Kasai-Sankuru-Lubefu. La direction moyenne des cours d'eau

y est Est–Ouest ou Sud-Est–Nord-Ouest; les plus septentrionaux décrivent une courbe dont l'allure rappelle, avec une certaine atténuation, la courbe du grand fleuve.

La figure 1 permet de voir sans difficulté ces diverses particularités du réseau hydrographique du Congo.

B. *Relation du Réseau avec l'Orographie*

Le réseau hydrographique du Congo, pris dans son ensemble, est en relation très nette avec la topographie générale, sauf pour ce qui concerne le bas Congo en aval du Stanley Pool. La carte orographique montre, en effet, les caractères suivants:

(1) Une ligne de crête que l'on désigne communément sous le nom de dorsale banguélienne, courant de l'Ouest à l'Est, forme la séparation des bassins du Congo et du Zambèze; les affluents du Kasai à cours Sud–Nord en descendent directement suivant la pente générale du terrain.

(2) A l'Est du Luapula, cette ligne de crête tourne vers le Nord pour former le pays de haut relief de la région des lacs. Tous les affluents de droite de la Luvua-Luapula et du Lualaba-Congo en descendent suivant la pente naturelle du sol. C'est de cette crête que descendent aussi vers l'Ouest, l'Aruwimi, l'Itimbiri, l'Uele, qui, dans la partie supérieure de leur cours, suivent ainsi la pente générale du sol.

(3) Au Nord du Congo-Belge, court une troisième ligne de relief orientée S.E.–N.W.; elle se détache de la précédente un peu au Nord du lac Albert et se dirige vers le Darfour; elle sépare le bassin congolais du haut bassin du Nil. L'Uele et le Bomu, dont la réunion forme l'Ubangi, l'Itimbiri, l'Aruwimi, coulent en réalité dans le creux descendant vers l'Ouest, compris ainsi entre la crête de l'Est et celle du Nord-Est. Les affluents de droite de l'Ubangi-Bomu, dans sa partie orientée Est–Ouest, coulent suivant la pente générale du versant.

(4) Du Darfour part une autre crête se dirigeant vers le Sud-Ouest, et qui limite au Nord-Ouest le bassin du Congo; elle sépare celui-ci du bassin du Tchad; les affluents de droite de l'Ubangi, en aval du grand coude de Zongo, en descendent directement.

(5) Enfin, parallèlement à la côte Atlantique, s'allonge la chaîne des Monts de Cristal qui ferme la cuvette centrale en se raccordant vers le Sud à la dorsale banguélienne. Des Monts de Cristal descendent vers l'Est de petits affluents du Congo et du Kwango (affluent du Kasai). Seul le fleuve Congo traverse cette crête en une gorge étroite, coupée de chutes et de rapides, pour gagner l'Atlantique.

En résumé. La disposition orographique générale se caractérise par une grande dépression centrale entourée de tous côtés par des zones de relief, formant une sorte de bourrelet périphérique à la zone déprimée. De ces crêtes descendent des cours d'eau qui se rendent vers la dépression en suivant la pente générale du sol et qui par conséquent convergent vers la grande cuvette. Le centre de celle-ci correspond à la grande boucle du Congo, à celle de l'Ubangi, au Lubefu-Kasai et à l'ensemble des rivières comprises entre ce cours et la courbe du Congo. Tous ces cours d'eau, grâce à cette disposition se réunissent en un seul point, le Stanley Pool dont le déversoir est le Congo inférieur.

Les deux croquis (fig. 2 et fig. 3) montrent clairement cette disposition.

C. *Relations avec la Constitution Géologique*

La disposition orographique est intimement liée à la géologie du centre africain. A l'exception des dépôts d'origine continentale, en relation directe avec la morphologie actuelle, l'intérieur de la cuvette congolaise est occupé par une importante masse de dépôts sédimentaires allant du Trias supérieur au Jurassique (au moins le Jurassique inférieur) désignés sous le nom de *système du Lualaba* à la base et de *système du Lubilash* au sommet. L'ensemble de ces dépôts est resté en couches sensiblement horizontales; ils ne sont pas plissés et seules les grandes dislocations radiales les ont affectés principalement dans l'Est du bassin congolais.

Le parallélisme des deux systèmes, leur succession en concordance de stratification, la difficulté de les séparer dans l'Ouest du bassin font que l'on peut les réunir au point de vue spécial qui nous occupe et employer l'expression de *système du Lualaba-Lubilash.* La bordure de la cuvette est constituée sur presque toute son étendue par des formations plus anciennes réparties dans plusieurs systèmes de plus en plus métamorphiques et de plus en plus disloqués au fur et à mesure que l'on descend davantage dans le série stratigraphique.

L'orographie générale du bassin du Congo est ainsi en concordance presque parfaite avec sa constitution géologique. Cette concordance peut s'expliquer de deux manières:

(*a*) La distribution des roches sédimentaires du système du Lualaba-Lubilash correspond au remplissage d'une grande cuvette lac ou mer intérieure, comprise entre des crêtes formées des roches plus anciennes.

(*b*) Ou bien la répartition actuelle de ces terrains est la conséquence

de légères déformations du sol et de l'érosion subséquente ayant fait disparaître, des zones anticlinales, la couverture du Lualaba-Lubilash; celle-ci n'aurait été conservée que dans les régions déprimées, donnant ainsi la disposition en une vaste cuvette que montre si bien la carte géologique.

La seconde hypothèse est le mieux en rapport avec les faits observés. Il est certain que la répartition actuelle des sédiments du Lualaba-Lubilash ne représente qu'une partie de la couverture originelle nivelée par l'érosion; les *outliers* ménagés sur les sommets (par exemple sur la crête banguélienne), les lambeaux descendus entre des failles, comme au voisinage du Tanganika, en sont la preuve la plus manifeste. Ensuite, la disposition des rivières notamment sur le versant nord de la dorsale banguélienne, dont la source est dans le substratum ancien et qui, dans la partie aval de leurs cours, coulent uniquement sur le Lualaba-Lubilash, met bien en évidence la légère courbure qu'ont prise les couches de ce système pour arriver à la disposition en cuvette si typique du bassin congolais.

En conséquence, il est permis de croire que la disposition du bassin hydrographique du Congo est la conséquence des déformations du sol qui ont affecté les couches les plus récentes et les ont courbées en une large cuvette ainsi qu'il est indiqué sur les figures 2 et 3.

D. *Les Anomalies du Réseau Hydrographique du Congo*

Cependant, la disposition actuelle du réseau ne concorde pas strictement avec la courbure en large cuvette des couches du système Lualaba-Lubilash et l'on relève une série d'anomalies qui obligent à faire intervenir d'autres facteurs. Les cours d'eau de la périphérie du bassin sont, il est vrai, disposés conformément à la pente générale du sol qui doit résulter de la courbure en cuvette des sédiments du Lualaba-Lubilash; mais, dans la partie centrale de cette cuvette, le réseau est anormal car ses différents éléments ne se dirigent pas vers le point qui normalement devrait être le plus bas et d'où partirait le collecteur général conduisant les eaux à l'océan.

Le Congo montre l'anomalie la plus frappante. En aval d'Ankoro (confluent de la Luvua) le fleuve donne en effet l'impression, par la grande courbe qu'il décrit, de vouloir couler parallèlement au bord de la cuvette au lieu de se rendre directement au point le plus bas (Stanley Pool). Le Haut Uele semblerait devoir gagner directement le Congo en empruntant la vallée de l'Itimbiri; au lieu de cela, il s'en écarte, suivant de plus près encore la bordure nord de la dépression, puis va décrire le grand coude de Zongo. C'est seulement

alors qu'il revient vers le Sud en suivant la bordure occidentale de la dépression centrale. D'autre part, les rivières à cours méridien qui descendent de la crête Congo-Zambèze devraient normalement continuer leur cours jusqu'au Congo, comme le fait le Lomami; au lieu de cela, elles sont recueillies par le sillon Lubefu-Kasai. Entre celui-ci et la grande courbe du Congo, s'est établi un réseau de rivières dont l'orientation semble due à la même cause qui a donné son allure au fleuve principal. Ces diverses anomalies permettent d'affirmer déjà que, si le réseau hydrographique du Congo est, dans ses grandes lignes, en relation avec les mouvements du sol qui ont déformé les couches sédimentaires les plus récentes du bassin, il n'en est pas moins vrai qu'il a subi l'influence de mouvements bien plus complexes qu'on ne serait tenté de le supposer par le simple examen des traits principaux de la carte géologique.

Le déversoir du grand réseau hydrographique, pour se rendre à la mer, doit traverser une chaîne montagneuse, les Monts de Cristal, en une gorge étroite semée de chutes et de rapides, montrant un relief très jeune en opposition avec l'allure calme du fleuve dans le grand bief en amont du Stanley Pool. Il convient d'ajouter à cela que la vallée du Congo se prolonge loin des côtes en une dépression sous-marine descendant jusque vers 2000 m. de profondeur.

Enfin, le long des affluents, au voisinage de la bordure de terrains anciens et à travers ceux-ci, se voient des rapides et des chutes témoignant d'un rajeunissement du relief; ce sont là des faits bien connus et expliqués sur lesquels je ne désire pas m'arrêter à nouveau; je désire seulement, au cours de ce travail, rechercher les causes de la forme générale du réseau hydrographique et de son orientation.

J'insiste cependant dès maintenant sur un point: si certaines parties du cours du fleuve principal et de ses affluents ont une allure très calme compatible avec l'état d'équilibre, les parties où dominent les chutes et rapides sont l'indice d'un rajeunissement récent. Ces indices de rajeunissement existent de façon tout à fait générale à la périphérie de la cuvette; ils se marquent très nettement sur le déversoir du Congo inférieur (en aval du Stanley Pool). Ils sont en harmonie avec une accentuation minime, sans doute, mais relativement très récente de la courbure de la cuvette centrale et de son bourrelet périphérique.

C'est là, semble-t-il, une raison péremptoire pour considérer les déformations antérieures de même type comme étant la cause profonde de toutes les anomalies du réseau hydrographique congolais.

E. *L'Explication de l'Origine du Réseau Hydrographique du Congo*

1. *Les idées généralement admises.* L'origine du réseau hydrographique du Congo n'a pas donné lieu jusqu'ici à beaucoup de controverses. L'hypothèse la plus généralement admise s'appuie sur des données géologiques d'ordre général.

Comme je l'ai rappelé, la dépression centrale du Congo est occupée par les dépôts subhorizontaux du Lualaba-Lubilash. Ces couches ne sont pas strictement horizontales; elles se relèvent doucement vers les bords de la cuvette. Il n'empêche que, dans sa disposition générale, abstraction faite des détails, le système du Lualaba-Lubilash occupe avec son maximum d'épaisseur toute la zone centrale de la dépression. Ces dépôts, les derniers de la série sédimentaire du bassin du Congo, à l'exception des dépôts continentaux en rapport avec le relief et le réseau hydrographique actuel (alluvions, dépôts lacustres, latérites, etc.), sont essentiellement gréso-schisteux; le calcaire y est tout à fait exceptionnel; les fossiles y sont peu abondants et sont des végétaux terrestres ou des animaux d'eau douce ou d'eau saumâtre.

Aussi, par tous ces caractères, le système du Lualaba-Lubilash donne l'impression de s'être accumulé dans un énorme lac ou une vaste mer intérieure, et l'on a cru pouvoir assigner à ce bassin de sédimentation une forme et une étendue tout à fait en rapport avec l'extension actuelle de ces dépôts. Les sédiments qui s'y seraient déposés, groupés aujourd'hui dans le système du Lualaba-Lubilash, résulteraient dans ce cas, d'apports de matériaux arrachés par des cours d'eau et accessoirement par des glaciers, aux crêtes entourant le bassin et correspondant à ce que j'ai appelé, dans les pages précédentes, le bourrelet périphérique. Par conséquence logique, on a admis que le réseau hydrographique du Congo a pris la disposition générale que nous lui connaissons, lorsque le lac s'est vidé.

M. M. Robert exprime bien cette pensée dans son ouvrage: *Le Congo physique*[1]:

"Le réseau des cours d'eau drainant actuellement le bassin congolais est né en partie lors du retrait du lac lubilashien; il est de date plus ancienne dans les zones qui ne furent pas immergées sous les eaux de cette mer intérieure triaso-jurassique."

"Les rivières nées sur les flancs de la cuvette au moment du retrait du lac lubilashien ont pris une direction conséquente par rapport à ce retrait. Les rivières principales convergeaient ainsi vers la zone la plus profonde de la cuvette. Un lac, moins étendu évidemment que

[1] M. Robert, *Le Congo physique*, p. 124, Bruxelles, 1923.

le lac lubilashien, a subsisté dans les bas fonds de la cuvette jusqu'à une époque très récente et son extension a pu varier à diverses reprises. Les dépôts et les marais que l'on trouve dans la vaste zone qui a Irebu et le lac Léopold II comme centre, attestent de son existence. Le cours du fleuve entre le confluent du Lomami et Bolobo est, d'ailleurs, un dernier reste de cette ancienne étendue lacustre plutôt qu'un fleuve proprement dit."

"A l'heure actuelle, la dépression de la cuvette congolaise est entourée de toute part par des régions plus élevées qu'elle-même et elle est séparée de l'Océan par le bourrelet du Congo occidental. Les eaux qui s'accumuleraient dans le fond du bassin ne peuvent se déverser dans l'Atlantique que par la gorge profonde taillée par le fleuve de Bolobo au Bas Congo et plus spécialement du Stanley Pool à Boma."

"On possède trop peu de données précises pour que l'on puisse dès à présent suivre pas à pas l'histoire de la formation de ce déversoir en goulot et déterminer les vicissitudes qu'il a traversées."

"On sait en tous cas que le creusement de la vallée inférieure du Congo est de date relativement récente. On admet généralement à l'heure actuelle qu'après l'effondrement de l'Atlantique Sud un fleuve côtier aurait reculé sa tête assez loin pour venir capter les eaux de la cuvette et permettre leur écoulement vers l'Océan. Delhaye et Sluys ont montré que ce fleuve côtier s'est établi dans le fond d'un plissement formé à l'époque jurassique. En creusant sa gorge de plus en plus profondément, le fleuve a permis au fond de la cuvette de s'assécher de plus en plus et d'aboutir ainsi au stade actuel. Ceci ne semble pas avoir dû se faire de façon absolument régulière cependant, soit à cause d'affaissements locaux de la cuvette, soit par suite de la surélévation du bourrelet que sciait transversalement le fleuve."

2. *Objections à cette théorie.* Cette manière de concevoir la formation du réseau hydrographique du Congo est très simple et très suggestive. Cependant, une étude plus approfondie fait apparaître des objections très graves que l'on peut énoncer de la manière suivante:

(*a*) Comme je l'ai dit tout à l'heure, la disposition du système du Lualaba-Lubilash dans la dépression congolaise donne évidemment à première vue l'impression d'une cuvette remplie par l'apport de matériaux venant des crêtes voisines. Cependant une telle conception est forcément inexacte car elle ne tient pas compte de l'érosion. Depuis le Jurassique, la région est certainement exondée et l'érosion s'est attaquée aux sédiments antérieurs; les rivières ont mis à nu le substratum ancien sous la couverture des dépôts horizontaux.

Comme je l'ai rappelé tout à l'heure, les lambeaux de ces dépôts, isolées, sur les points élevés du plateau suivant la dorsale banguélienne marquent encore l'ancienne extension de la formation du Lualaba-Lubilash; les documents que nous possédons sur la géologie des contrées au Sud du Congo-Belge indiquent la continuation de ces terrains au delà de la crête d'allure anticlinale formant la bordure sud de la cuvette congolaise. A l'Est de celle-ci, des lambeaux des mêmes formations s'étendent jusqu'au delà du lac Tanganika montrant bien que dans cette direction les dépôts du Lualaba-Lubilash n'étaient pas limités à la ligne actuelle de hauteurs suivant la région des lacs.

On peut donc prétendre avec raison que la répartition actuelle du système Lualaba-Lubilash au Congo est la conséquence des déformations postérieures à leur sédimentation et à l'érosion subséquente. Dans ces conditions, il ne peut plus être question de la formation du réseau par l'écoulement des eaux de ruissellement vers un grand lac et vidange ultérieure de celui-ci par suite de l'érosion régressive d'une rivière atlantique.

(*b*) Dans la cuvette congolaise elle-même, on peut trouver des faits en opposition avec l'hypothèse d'une mer intérieure correspondant à la cuvette congolaise actuelle. En effet, si le système du Lubilash a un faciès gréseux relativement constant dans toute l'étendue du Congo et même en dehors de la cuvette, il n'en est pas de même du système du Lualaba. Celui-ci a le faciès arénacé à l'Ouest, tandis que vers l'Est, il passe progressivement au faciès argileux avec schistes bitumineux ou schistes noirs; vers le Nord et le Nord-Est, on y trouve aussi des intercalations calcaires. Si la sédimentation s'était effectuée dans une cuvette ayant approximativement la forme actuelle du dépôt, les faciès seraient disposés concentriquement et non pas suivant une direction transversale à la cuvette; on ne peut pas supposer, en effet, que la disposition observée soit la conséquence d'une différence dans la nature des roches anciennes de la ceinture, car elle se marquerait aussi bien dans les couches du Lubilash que dans celles du Lualaba.

D'autre part les fossiles rencontrés dans les couches du Lualaba marquent un faciès plus ou moins saumâtre vers le Nord. C'est ce qui semble indiquer la probabilité d'une communication avec la haute mer dans cette direction.

La question n'est sans doute pas aussi simple que je viens de l'exposer. On doit, en effet, faire observer qu'à l'Ouest du Tanganika, dans le Maniema, on a signalé la présence de dépôts glaciaires à la base du système du Lualaba et l'on a pu montrer le passage de ces

dépôts morainiques à des sédiments normaux. Il en résulte qu'à cette époque il existait, dans cette partie du Congo, une zone élevée d'où descendaient des glaciers. On peut penser que cette zone de haut relief formait la bordure orientale de la cuvette. Certaines particularités observées dans la disposition des couches du système du Lualaba sembleraient indiquer que la région était de relief relativement accidenté. Cependant, les dépôts du système du Lubilash, les derniers formés, ont pour l'étude de l'origine du réseau hydrographique congolais une importance bien plus grande que les formations du début du système du Lualaba puisque ce réseau s'est établi sur les couches du Lubilash.

Or, l'identité d'aspect de la série du Lubilash sur les bords du Tanganika (Lukuga) et dans l'Est de la cuvette congolaise tend à montrer que, à la fin de cette période, les conditions de sédimentation étaient uniformisées et que la zone de relief du Maniema-Tanganika était effacée au moins provisoirement. Il n'empêche qu'on peut croire qu'elle devait avoir une tendance à se soulever davantage que les régions voisines. Nous en aurons la preuve tout à l'heure.

(*c*) Si la vidange du lac supposé était de date récente, suivant l'hypothèse rappelée ci-dessus, on ne comprendrait pas que la sédimentation si active pendant le Trias et le Jurassique inférieur ait cessé de façon presque complète depuis cette époque alors que les cours d'eau descendant du bourrelet périphérique entamaient profondément les terrains dans lesquels ils ont encaissé leur vallée.

(*d*) Enfin, comme je l'ai déjà fait observer, la disposition du réseau n'est pas conforme à la notion de la vidange d'un bassin de sédimentation par suite d'une échancrure produite dans sa bordure par érosion régressive d'un affluent de l'Océan Atlantique. Il faut donc de toute manière faire intervenir des phénomènes plus complexes.

3. *Explication basée sur les déformations de l'écorce terrestre.* Malgré ses anomalies, le réseau hydrographique du Congo montre une orientation conforme à une règle dominante: la grande courbe décrite par le fleuve, courbe qui se répète dans l'Ubangi-Uele et dont on trouve aussi la trace dans la disposition des cours d'eau entre le Congo et le Lubefu-Kasai. On peut faire à ce sujet une première hypothèse: la direction du fleuve principal serait partout conséquente à un ancien rivage se déplaçant constamment; ou bien, le tracé du fleuve serait la conséquence de modifications progressives du sens de la pente du sol au fur et à mesure de l'allongement du fleuve, lors de la surrection du territoire. Cette hypothèse ne paraît cependant pas devoir être envisagée; en effet, les dépôts de la région côtière, appartenant au

Crétacique supérieur et au Tertiaire, et auxquels le cours inférieur du Congo est sensiblement conséquent, ne succèdent pas normalement aux terrains de l'intérieur; ils en sont séparés par une déformation d'ordre tectonique. Il y a donc lieu de préciser l'évolution géologique du pays au point de vue spécial de l'orientation du réseau hydrographique.

(*a*) Si le cours inférieur du Congo est sensiblement conséquent au rivage de l'Atlantique actuel, on peut montrer qu'il est conséquent aussi au rivage de la mer crétacée. Le Crétacique inférieur existe dans le Sud de l'Angola. Vers le Nord, le long de la côte, le Crétacique supérieur s'avance en transgression et les sédiments du Crétacique inférieur n'existent pas dans les régions sahariennes; les grandes affinités des faunes de ce niveau dans l'Afrique du Sud-Ouest et dans l'Afrique du Nord portent à croire qu'il y avait communication entre la mer du Sud et celle de la Méditerranée par l'axe de l'Océan Atlantique. Aussi, au Nord de l'Angola faut-il incurver le rivage du Crétacique inférieur pour l'orienter Nord-Ouest–Sud-Est. On remarque que le cours inférieur du Congo est alors conséquent au rivage dirigé de cette manière.

Il n'y a aucune raison d'admettre que le Crétacique s'est étendu bien loin vers l'intérieur du continent au delà de la bande occupée par ses dépôts. Le cours supérieur du Congo et ses affluents principaux ont donc pris naissance sur les formations antérieures au Crétacique; l'allure de ces formations est tout à fait différente de celle du Crétacique; elles avaient été déformées avant l'arrivée de la mer crétacée sur la côte atlantique. Le cours supérieur du Congo avec ses affluents, non conséquent à la mer Crétacique, parallèle même au rivage de celle-ci, doit être antérieure au Crétacique et en concordance avec les mouvements de l'écorce terrestre qui l'ont immédiatement précédé.

(*b*) Le cours du Congo supérieur et de ses affluents importants a pris naissance évidemment sur les sédiments du système Lualaba-Lubilash dès que ceux-ci furent exondés quelle que fut la nature du bassin de sédimentation où ils se formaient (mer ouverte, mer intérieure, lac, plaine marécageuse). Or, il est possible de se faire une idée des déformations subies par les couches du Lualaba-Lubilash.

A une époque postérieure au Jurassique inférieur, mais antérieure au Crétacique inférieur de la côte d'Angola, il s'est produit des mouvements du sol, dont l'un des plus caractéristiques consiste en une large ride anticlinale orientée Ouest-Nord-Ouest–Est-Sud-Est, allant approximativement de Saint Paul de Loanda à Élisabethville (Congo-

Belge). Cette ride anticlinale sépare la cuvette congolaise de la grande extension de dépôts du Karroo (Lualaba-Lubilash) dans le Sud-Ouest de l'Angola et la Rhodésie du Nord. Cette ride est parallèle à un autre axe anticlinal qui a joué un rôle important pendant la formation même du système du Karroo, car, suivant une large zone joignant la frontière Sud de l'Angola au centre de la Rhodésie du Sud, le Karroo se présente avec son minimum de développement et ses assises supérieures seules paraissent représentées. Il existe ainsi entre la grande cuvette du Congo-Belge et celle du Cap-Orange, une importante zone complexe à tendance anticlinale. Une légère accentuation de cette zone ou de sa partie septentrionale suffisait pour faire exonder le bassin de sédimentation où s'accumulaient les couches du système du Lubilash au Congo-Belge, et permettre à des cours d'eau de s'établir sur ce territoire. On peut croire ainsi que, sur le versant nord de cette crête anticlinale, descendaient vers le Nord des cours d'eau creusant leur vallée dans les dépôts du Lualaba-Lubilash.

Ces mouvements du sol se sont effectivement produits avant le début du Crétacique car les dépôts de cette dernière période affleurant sur le rivage atlantique, sont tout à fait indépendants, quant à leur allure, des dépôts du Lualaba-Lubilash. C'est ce que montre la figure 4.

Aucune sédimentation générale ne s'étant faite postérieurement à ce mouvement dans le centre africain, on peut faire remonter à cette époque l'origine des rivières à cours méridien du bassin du Kasai, ainsi que le cours supérieur du fleuve principal, c'est-à-dire le Lualaba et le cours du Lomami. Le cours supérieur du fleuve a donc pris naissance à une époque bien antérieure au cours inférieur.

Il convient de chercher à suivre ces cours d'eau descendant de la crête Congo-Kasai et savoir où ils se rendaient à l'origine. La sédimentation de la puissante série du Lualaba-Lubilash est un épisode de l'édification du système du Karroo dans l'Afrique Australe. Cette grande masse de couches à faciès essentiellement continental, d'après les caractères de sa faune et de sa flore, succède à une période d'érosion dont la durée semble avoir été d'autant plus longue que l'on s'écarte davantage des côtes pour se rapprocher de l'intérieur du continent africain.

C'est ainsi que dans l'Afrique Australe, la disposition transgressive du Sud vers le Nord des dépôts successifs du Karroo est particulièrement nette. Dans l'Est du continent, on trouve, au voisinage du canal de Mozambique, des représentants de l'assise d'Ecca, tandis que vers l'Ouest, les couches de Beaufort sont transgressives et dans la majeure

partie du bassin du Congo, le système du Lualaba-Lubilash, équivalent *lato-sensu* des couches de Stormberg de l'Afrique Australe, repose directement sur le substratum ancien. Une telle disposition ne peut se comprendre que dans l'hypothèse d'un abaissement progressif du continent, surélevé à la période précédente, de façon à permettre une abondante sédimentation soit marine, soit lagunaire, soit continentale sur un sol bas voisin du niveau de la mer.

La disposition transgressive se faisant de l'Océan Indien vers le Congo est marquée non seulement par le répartition des assises du Karroo, mais aussi par les changements de faciès du Trias et du Jurassique. Le Trias marin se rencontre dans le Nord-Est de Madagascar, le Trias lagunaire se trouve dans l'Est de l'Afrique au Nord de l'équateur, et dans tout l'Ouest de Madagascar le tracé des zones isopiques à cette époque s'établit ainsi sans difficulté. A l'époque du Jurassique inférieur, le faciès marin s'étend dans l'Est de l'Afrique là où était le Trias lagunaire; l'avancée de la mer vers l'Ouest s'indique ainsi de façon très nette et elle correspond à la disposition transgressive de l'assise de Stormberg[1]. Bien plus, la limite entre les deux faciès observés dans le système du Lualaba (gréseux au Sud-Ouest, schisteux vers le Nord-Est) au Congo-Belge est en harmonie avec cette disposition transgressive.

Par contre, le faciès gréseux uniforme du Lubilash, succédant dans l'Est du Congo au faciès schisteux du Lualaba, indique le report vers l'Est, ou plutôt vers le Nord-Est, de conditions de sédimentations cantonnées d'abord à l'Ouest; il marque le début du mouvement de soulèvement ayant eu pour conséquence de chasser les eaux du bassin de sédimentation. Il est donc vraisemblable que ce bassin où se déposaient les roches du Lubilash était en communication plus ou moins facile avec la mer jurassique par le Nord-Est du Congo.

Il est à remarquer que, dans le Nord de l'Afrique, le Jurassique est transgressif vers le Sud par rapport au Triasique. Le mouvement de transgression, venant ainsi du Nord comme de l'Est et coïncidant avec une tendance au soulèvement de la ride anticlinale séparative du Congo-Zambèze, permet de comprendre que les cours d'eau descendant sur le flanc nord de cette ride aient eu une tendance à s'étendre vers le Nord bien plus loin qu'ils ne le font aujourd'hui. Mais ce ne fut là qu'un stade passager dans l'évolution du réseau; le mouvement se fit immédiatement plus complexe.

Lorsqu'on cherche à préciser l'évolution du continent africain au

[1] J'ai fait observer précédemment que le phénomène fut, en réalité, plus complexe, car il convient de tenir compte des dépôts glaciaires.

cours des périodes géologiques, on constate que la mer du Crétacique inférieur est en régression dans l'Est par rapport au Jurassique; sur la côte occidentale, au contraire, elle s'avance vers le Nord-Nord-Est en allure transgressive, recouvrant directement de ses sédiments le substratum cristallophyllien. Une telle disposition différente sur les deux bords du continent peut s'expliquer par un bombement de l'axe ancien de l'Afrique orientale forçant la mer à reculer vers l'Est, lui permettant par contre d'avancer à l'Ouest. On peut croire, d'après les déformations subies par les couches du Lualaba-Lubilash, que le bombement ne se fit pas suivant une ligne strictement méridienne, mais suivant une ligne brisée correspondant aux traits caractéristiques de la tectonique de la région, dont l'orientation moyenne est approximativement du Nord au Sud.

A ce double mouvement, il faut ajouter l'accentuation d'un autre trait directeur de la géologie africaine. On sait que l'Afrique est divisée en deux parties bien distinctes au point de vue géologique par un grand axe anticlinal courant de la Guinée à l'Abyssinie et dont l'influence s'est fait sentir pendant les périodes successives de son évolution par une tendance permanente à la surrection[1]. La disposition régressive du Crétacique inférieur par rapport au Jurassique dans le Nord de l'Afrique, alors que suivant l'axe Guinée-Abyssinie le Crétacique supérieur recouvre directement le substratum ancien, montre que cet axe anticlinal s'est accentué au début du Crétacique. Il en résulte qu'au cours de cette dernière période il s'est produit, dans le centre de l'Afrique, une déformation très complexe: soulèvement d'un axe méridien en ligne quelque peu brisée et accentuation de l'axe est–ouest Guinée-Abyssinie.

Une semblable déformation devait avoir une répercussion marquée sur le réseau hydrographique orienté tout d'abord par le soulèvement d'une ride plus méridionale ainsi qu'il a été exposé précédemment. Il s'est produit une déviation vers l'Ouest avec probablement formation d'un lac temporaire; la forme en chenal ouvert vers l'Ouest si caractéristique du Nord-Est du Congo a vraisemblablement pris naissance à cette époque.

On conçoit que de telles déformations de la croûte terrestre aient eu pour effet de modifier profondément l'allure générale d'un premier réseau hydrographique et aient donné naissance à la première

[1] Comme je l'ai établi dans un travail antérieur, cette zone axiale Est–Ouest est en réalité formée de l'ajustement de partie correspondant à deux directions conjuguées: S.W.–N.E. et N.W.–S.E. (P. Fourmarier, "Les traits directeurs de l'évolution géologique du Continent africain," *Publ. Congrès Géol. Intern.* XIV[e] *Session*, Madrid, 1926.)

ébauche de la grande courbe du fleuve. C'est sans doute ici qu'il conviendra de faire intervenir l'érosion régressive d'un cours d'eau atlantique correspondant au Congo inférieur, cours d'eau conséquent au rivage de la mer crétacée de l'Atlantique; ce cours d'eau en reculant sa source vers l'intérieur du continent, par suite de l'augmentation de la pente résultant du soulèvement central et de la transgression de la mer, a facilité l'écoulement des eaux dans la direction de l'Ouest.

On admettra sans peine que dans la partie correspondant à la boucle du Congo, il ait pu se former un lac temporaire jusqu'au moment où s'établit définitivement le tracé actuel pour les raisons exposées ci-dessus. Il est indispensable de faire intervenir des mouvements aussi complexes sinon les particularités du réseau restent inexplicables. L'évolution géologique de l'Afrique centrale nous apprend que ces mouvements furent réels; il n'est pas possible d'en faire fi dans la recherche de l'origine du réseau hydrographique congolais. En réalité, il faut compléter encore cette vue d'ensemble; mais avant cela, il convient de répondre à une objection possible.

La zone montagneuse qui limite la cuvette congolaise du côté de l'Ouest paraît, en effet, en opposition avec la théorie exposée, mais il faut bien se figurer que cette zone de crête s'est formée ou tout au moins fortement accentuée à une époque relativement récente par un ridement du sol abaissant la région ouest sous la mer et soulevant la région des Monts de Cristal en accentuant leur courbure; c'est ce que montre le croquis de la figure 5. C'est, je crois, la seule façon d'expliquer à la fois la vallée sous-marine prolongeant le cours du fleuve à grande distance sous la mer, l'aspect rajeuni de la vallée entre la plaine côtière et le Stanley Pool, ainsi que la présence de terrasses fluviales en amont de ce dernier. On observe, d'ailleurs, dans le Crétacique et le Tertiaire, des ondulations et des fractures parallèles à la côte atlantique. Cette accentuation du bourrelet tendrait plutôt à former des lacs dans la cuvette centrale et l'on peut admettre que les lacs Léopold II et Tumba sont la conséquence du soulèvement du bourrelet des Monts de Cristal plutôt que des lacs résiduels.

Je ne voudrais pas m'égarer dans des digressions trop longues par une étude comparative avec d'autres régions; je ne puis cependant m'empêcher de voir une grande analogie entre l'évolution du fleuve Congo et celle de la Loire en France dont l'étude est plus commode parce que le phénomène s'est réalisé à une époque plus récente; l'érosion n'a pas eu le temps comme en Afrique centrale de faire disparaître les documents les plus convaincants pouvant servir à établir l'histoire du réseau hydrographique.

La disposition du réseau à l'intérieur de la grande courbe du fleuve et au Nord du sillon Lubefu-Kasai demande encore un complément d'explication, car elle paraît difficile à comprendre. Je pense qu'elle résulte de la complexité même des mouvements du sol qui ont affecté la région et que j'ai fait intervenir pour expliquer la disposition générale du réseau. L'examen de la carte hypsométrique du Congo est particulièrement suggestive à cet égard. Si l'on trace la courbe d'altitude de 500 m., on remarque l'existence d'une sorte de plateau à bords assez massifs, d'axe Nord-Ouest–Sud-Est, s'avançant entre le Sankuru-Kasai et le Bas Lomami. Le cours moyen de ce dernier fleuve est encaissé dans ce plateau et, chose remarquable, là où il franchit la bordure nord-est de ce plateau, il est coupé de rapides, qui arrêtent la navigation.

Or, il est à remarquer que l'orientation de cette zone de relief est parallèle à la direction des fractures du type Tanganika dont j'ai observé la présence le long de la Lukuga supérieure et notamment à la Niemba. Ces fractures sont postérieures au Lualaba-Lubilash qu'elles découpent, mais il est de bonnes raisons de croire qu'elles s'amorçaient pendant la formation même de ce terrain.

Lors des dislocations qui ont marqué la naissance du réseau hydrographique actuel du Congo, certaines d'entre elles ont permis le soulèvement de massifs qui ont eu pour effet de modifier, sur une étendue plus ou moins grande, la distribution des rivières. Le soulèvement du massif du Sankuru, avec ennoyage vers le Nord-Ouest, a d'ailleurs contribué, en partie sans doute, à donner à la grande courbe du fleuve son aspect actuel. Il a eu pour conséquence la séparation du Kasai et la tendance à la réunion suivant un chenal unique Lubefu-Kasai des eaux descendant du Sud en une série de vallées parallèles. Le Congo (Lualaba) et le Lomami ont seuls été assez puissants pour ne pas être déviés par le mouvement de soulèvement suivant une direction plus ou moins transversale à leur cours. Les mouvements secondaires, effondrement ou gauchissements locaux, ont alors donné au réseau ses particularités locales, telles que le fossé parsemé de lacs dans lequel coule le Lualaba en aval de Bukama.

Les études récentes de M. l'Abbé Salée vont même jusqu'à prétendre que le lac Tanganika voyait autrefois ses eaux se rendre dans le bassin du Nil. Je pourrais citer encore d'autres faits mettant en évidence certaines particularités du réseau, soit de date récente, soit accentuées à une époque relativement proche, mais ce serait sortir de mon sujet. Je désire me limiter à la question de l'orientation générale du réseau hydrographique.

En résumé: L'origine du réseau hydrographique du Congo résulte de mouvements complexes du sol. La série des cours d'eau à cours Sud–Nord descendant de la crête Congo-Zambèze paraît marquer l'orientation originelle du réseau correspondant à un ridement Est–Ouest dans la région située au Sud de la frontière du Congo.

La grande boucle du fleuve paraît être la conséquence d'une modification profonde du relief par soulèvement de la grande ride de la région des lacs en même temps que de la ride Guinée-Abyssinie. C'est la combinaison de ces lignes de relief qui explique l'orientation de l'Uele, du Bomu, de l'Itimbiri.

La ride des Monts de Cristal se serait accentuée à un époque plus récente donnant au déversoir du bassin un cours torrentiel.

Le soulèvement du massif du Sankuru-Lomami, expliquant à la fois les particularités du réseau à l'intérieur de la grande boucle du fleuve, serait peut-être là une action secondaire dans la forme même de cette boucle.

Cette manière de concevoir les choses est bien différente de celle que je rappelais tout à l'heure et qui consiste à supposer l'existence d'un grand lac d'âge jurassique dont la vidange résulterait du recul d'un affluent de l'Atlantique devenu par la suite le Congo en aval du Stanley Pool.

LÉGENDES DES FIGURES

Fig. 1. Carte du réseau hydrographique du Congo.

Fig. 2. Coupe Nord–Sud à travers la dépression du Congo.
A = substratum ancien;
L = système du Lualaba-Lubilash.

Fig. 3. Coupe Ouest–Est à travers la dépression du Congo et suivant le cours inférieur du fleuve Congo.
A = substratum ancien;
L = système du Lualaba-Lubilash.

Fig. 4. Schéma de la disposition des terrains crétacés (C) par rapport aux terrains antérieurs (substratum ancien et système du Lualaba-Lubilash) avant les déformations récentes qui ont formé les Monts de Cristal.

Fig. 5. Schéma montrant l'influence des déformations récentes sur le profil longitudinal du Congo inférieur.
N N = niveau de la mer;
A B = profil originel du fleuve;
A C = profil originel du fond de la mer;
R P = profil actuel de la fond de la mer;
Q R = vallée sous-marine;
R S T = profil actuel des Monts de Cristal;
R U V = profil actuel du Congo inférieur avec ses chutes et rapides.

Fig. 1

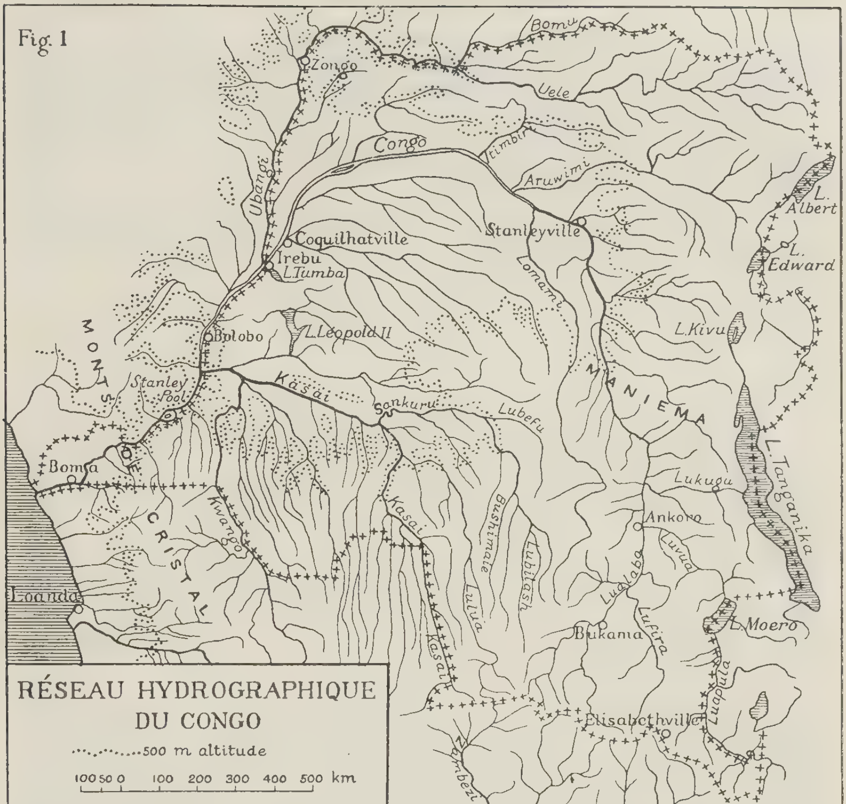


Fig. 2

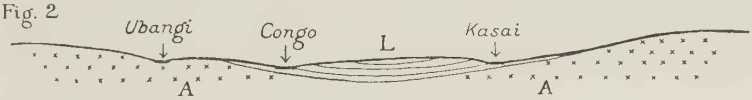
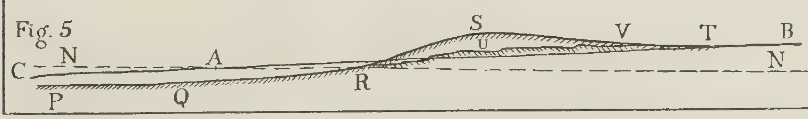


Fig. 3

Fig. 4

Fig. 5



DR M. A. LEFÈVRE: À l'opposition de l'application tectonique du cours anormal du fleuve Congo il y aurait peut-être lieu d'émettre l'hypothèse d'une prépondérance prise par un cours d'eau subséquent est–ouest, accompagnée de captures, à la suite d'affaissement de la région occidentale de la cuvette, et dont le résultat serait d'avoir donné au fleuve un tracé en grand arc de cercle. L'avancée du plateau de 500 m. pourrait aussi être un massif résiduel plutôt qu'un bombement tectonique.

M. H. HUBERT se borne à demander à M. Fourmarier s'il ne lui semble pas que le tracé si particulier du cours du Congo et des certains de ses affluents est dû, au moins en partie, à des phénomènes de capture récent.

PROF. GREGORY congratulated Prof. Fourmarier on the convincing statement of his explanation of the Congo River system. Prof. Fourmarier's explanation agreed well with evidence from countries to the East and North-East.

PROF. CHAPUT: Le remarquable exposé de l'évolution tectonique mésozoïque du Congo paraît indiquer une hydrographie déjà fixée dans ses grandes lignes avant le Tertiaire. Or, dans d'autres bassins d'affaissement et de gauchissements mésozoïques, le bassin de Paris par exemple, il y a une hydrographie datant en fait du Tertiaire et du Quaternaire. Il est intéressant et curieux que l'hydrographie du Congo soit fixée dès avant le Tertiaire.

M. L. AUFRÈRE pense qu'il faut tenir compte, dans l'évolution hydrographique du Congo, des événements de l'ère Tertiaire et Quaternaire. Dans une région voisine il y a eu des événements considérables et relativement récents. Le Tchad se trouve sur un erg fossile représentant un passé désertique où le réseau hydrographique n'existait pas, et ce passé ne pourrait guère remonter au delà du Quaternaire.

PROF. EMM. DE MARTONNE: La dépression du bassin du Congo paraît, d'après les observations du Prof. Fourmarier, pouvoir être comparée, en grand, aux bassins tertiaires de la zone hercynienne d'Europe. Par exemple, à la Limagne, qui n'est pas comme on le dit, la suite directe d'un lac tertiaire, mais correspond à un fossé tectonique, dans lequel se sont conservés les dépôts continentaux dont on trouve des restes sur les horsts encaissants. Toutefois la Limagne et les bassins analogues doivent certainement leur caractère de dépression à l'érosion des couches tertiaires moins résistantes que les horsts. On peut se demander s'il n'en est pas de même pour le bassin du Congo. Ce que semble le prouver c'est qu'il y a certainement des phénomènes de surimposition, notamment dans le Nord-Est, où le Congo entaille le sol ancien. D'accord avec M. Chaput je pense qu'on doit vivement désirer des précisions sur l'histoire tertiaire du Congo. Il faut espérer que le progrès des recherches géologiques, évidemment très difficiles ici, permettra de retrouver des séries des formations analogues à celles qui ont été trouvées dans l'Afrique orientale.

La grande difficulté dans la morphologie du Congo est la gorge du fleuve dans les Monts de Cristal. L'explication adoptée par Fourmarier est l'*antécédence*, théorie dont la vogue paraît bien passée et dont les applications ont été souvent reconnues inacceptables. On se demande si dans le cas présent on n'arriverait pas plus près de la vérité en considérant l'érosion différentielle, qui a créé en arrière de la barrière la dépression actuelle.

PROF. FOURMARIER: Je répondrai à l'observation de Mlle Lefèvre en faisant remarquer que le Lomami et le Lualaba (Congo supérieur) traversent la crête séparative du Lubefu-Sankuru-Kasai et du Congo; il est vraisemblable qu'ils n'ont pas été détournés par le soulèvement de ce massif parce qu'ils étaient assez puissants pour continuer leur creusement et imposer leur cours. Les captures dont parle M. Hubert existent incontestablement dans plusieurs

parties du Congo, notamment au Katanga et dans la région du Tanganika; ce dernier lac ne serait tributaire du bassin du Congo que depuis une époque relativement récente, d'après les recherches du Prof. Salée. Les observations de MM. Chaput et Aufrère sont tout à fait judicieuses; mais malgré toutes les recherches on ne connaît pas de formations plus récentes que le Jurassique si ce n'est des dépôts en relation directe avec la forme actuelle du réseau. A la suite des observations d'ordre général de M. de Martonne, je dirai que les phénomènes de surimposition sont tout à fait évidents. L'érosion a dû être énorme dans le bassin du Congo depuis son édification. Quant au cours inférieur du Congo, l'antécédence ne me paraît pas pouvoir être écartée. La forme de la vallée du fleuve avec ses rapides et la longue vallée sous-marine sont de bons arguments à l'appui de cette manière de voir.

PER LO STUDIO DELLE VARIAZIONI DEI LITORALI SABBIOSI DEL BACINO MEDITERRANEO

PROF. A. R. TONIOLO

In Italia, le osservazioni e gli studi sui litorali sabbiosi marittimi hanno lunga e onorata tradizione, sia che si tratti di ricerche sugli aggetti presso le foci dei fiumi, sia sui cordoni litorali delle falcate coste tirrene, o sugli apparati lagunari dell' Alto Adriatico.

Dai grandi matematici e idraulici nostri dei sec. XVIII e XIX, fino agli studiosi più recenti v' è tutta una serie di studi relativi alla genesi ed evoluzione di tratti diversi di spiagge italiane; e ciò per scopi puramente scientifici, ovvero per applicazioni pratiche.

Tali osservazioni riguardano anche eventuali spostamenti, positivi o negativi, della linea di spiaggia col volgere degli anni, spostamenti che interessano così la storia delle mutazioni fisiografiche del nostro suolo, come le condizioni di insediamento e d' ambiente di popolazioni marittime antiche od attuali, oppure problemi tecnici per esecuzione di bonifiche, porti, dighe, ecc.

Tali ricerche però, non si presentano ancora coordinate fra loro, nè perseguite con metodi simili e con le stesse finalità, onde i risultati sono difficilmente comparabili, nè si prestano a ricavare deduzioni generali sull' eventuale andamento periodico dei fenomeni relativi alle spiagge sabbiose.

Invero, nel 1926, il compianto *Olinto Marinelli*, in una breve memoria[1], aveva tentato uno studio complessivo di tali forme costiere italiane, indagando il meccanismo evolutivo e l' età relativa degli aggetti deltizi dei principali fiumi italiani, che egli divideva in tre fasi principali di evoluzione. La *Fase alfa* o iniziale sarebbe quella di riempimento del seno marino, da parte dei materiali trasportati dal

[1] Marinelli, O., "Sull' età dei fiumi italiani," *La Geografia*, XIV, pp. 21–9, Novara, 1926.

fiume, stadio in cui si trovano ancora, ad es., le foci di molti fiumi della Sardegna. La *Fase beta*, o intermedia, lagunare, con cordoni sabbiosi sottomarini, che separano un tratto di mare costiero dal mare libero, rappresenterebbe uno stato transitorio di tutti i fiumi, ma che si è conservato alla foce dei grandi corsi d' acqua dell' estuario veneto, per le condizioni di marea dell' Alto Adriatico e l' azione regolatrice dell' uomo. La *Fase delta*, ad aspetto triangolare o a lobi, a seconda delle condizioni idrauliche del fiume e del mare costiero, si ha soprattutto nel Tirreno alla foce dei grandi fiumi, per la maggiore profondità di questo mare, e nell' Adriatico poco profondo anche alle bocche dei minori corsi d' acqua.

Ma tali formazioni alluvionali deltizie, contrariamente a quanto pensava il *Credner*[1], pur potendo avvenire in aree di locali sollevamenti o sommersioni, trovano le condizioni più favorevoli al loro sviluppo in un regime di stabilità del livello del mare, che da noi deve essere succeduto ad un periodo di sommersione delle regioni costiere, le cui tracce, non solo sono visibili lungo i mari italiani, ma anche lungo tutto il bacino del Mediterraneo. Si venivano così a confermare le conclusioni dei vecchi geologi francesi (*Dolomieu*, *De Beaumont*, ecc.), che parlavano di una "età dei Delta," come una età di riposo o di stabilità bradisismica, la quale dovrebbe contare, secondo il *Lapparent*[2], un piccolo numero di migliaia di anni. Infatti, come riteneva il *Marinelli*, tale periodo dovrebbe coincidere, all' ingrosso, coll' inizio del periodo storico, almeno nel nostro bacino Mediterraneo, giacchè le formazioni deltizie italiane non risulterebbero più vecchie degli ultimi 2 o 3 millenni. Il *Marinelli* si augurava che tale problema fosse maggiormente approfondito, con uno studio metodico dei delta e delle spiagge basse di tutti i paesi di antica civiltà, come quelli mediterranei.

L' Istituto di Geografia Generale della R. Università di Pisa, in questi ultimi anni, ha iniziato una serie di ricerche fisico-storiche su tutta la fascia litoranea toscana, fra l' Arno e la Magra, e posto in evidenza il vario andamento degli antichi apparati deltizi e i corrispondenti cordoni di dune, pei quali fu tentata poi la cronologia relativa, e le corrispondenti fasi d' evoluzione di tutta la zona costiera, in relazione anche alle condizioni d' insediamento di antiche popolazioni e all' attività umana attraverso i secoli, rivolta alla regolazione dei corsi d' acqua e all' acquisto di sempre nuovi terreni di sfruttamento.

Da queste ricerche è risultato, che nel litorale toscano non si ris-

[1] Credner, F., "Die Deltas," *Peterm. Mitt. Ergänzungsheft*, LVI, Gotha, 1876.
[2] Lapparent, A., *Traité de Géologie*, Paris, 1883.

contra un processo uniforme e continuo nell' incremento degli apparati deltizi e dei litorali sabbiosi intermedi; bensì uno sviluppo alternato a fasi diverse per andamento ed attività, che potrebbero dipendere così da una mancanza di stabilità delle condizioni fisiche (livello medio marino, correnti di deriva, elementi metereologici, ecc.) come alla varia attività umana nei secoli, sull' andamento del corso inferiore dei fiumi, o sul rimaneggiamento superficiale dei loro bacini imbriferi, ciò che ha corrisposto ad una variazione nel carico delle torbide trasportate e nelle deposizioni di esse, con mutazioni di stile costruttivo e diverso sviluppo della zona deltizia. Così dopo una *fase alfa* preistorica di colmamento del seno pisano, dovette succedere una *fase beta* del periodo ligure-etrusco, prevalentemente lagunare, e quindi una *fase delta* in epoca romana con limitazione sempre maggiore degli specchi d' acqua e intensa colonizzazione; mentre durante l' alto Medio-Evo, per il disordinato spagliarsi delle acque fluviali, per le diminuite portate delle torbide, per l' assestamento dei materiali alluvionali precedentemente deposti, ecc., la regione costiera dovette nuovamente essere invasa dalle acque e ritornare in *fase beta*, che rappresenta un periodo di stasi o di rallentamento della formazione litoranea, con tratti morfologici ancor oggi evidenti e che referti storici e toponomastici ci dicono prolungata con tutta probabilità fino al 1000 d.C. Gli aggetti fluviali dei fiumi Serchio ed Arno entro il mare aperto e le dune relative, corrispondenti ad una ripresa della *fase delta*, nonchè la falcatura complessiva della spiaggia, appartengono tutti agli ultimi 8 secoli; anzi la curva di equilibrio orizzontale del tratto di costa tirrena, che va dai Mti. Livornesi al C. Corvo, può dirsi raggiunta solo nella prima metà del sec. XIX. La seconda metà di questo secolo invece, mentre vide iniziarsi una rapida *fase beta* per la foce di Magra, che per condizioni locali era ancora in *fase alfa*, constatò il massimo sviluppo della *fase delta* del tratto inferiore litorale, col rapido protendersi delle foci triangolari dell' Arno e del Serchio. Queste raggiunsero la massima espansione attorno al 1880, così da disturbare il profilo d' equilibrio già raggiunto dalla costa.

Da allora si è iniziata una riduzione dei lobi deltizi, che si è estesa progressivamente da sud verso nord, dall' Arno fin oltre Viareggio, e che sembra tenti riportare la spiaggia alla falcatura d' equilibrio, raggiunta nella prima metà del sec. XIX[1].

Ma tale fase di ritiro della cimosa di spiaggia in questi ultimi anni, non fu solo constatata sul litorale toscano, ma in molti altri punti delle

[1] Cf. Toniolo, A. R., "Le variazioni storiche del litorale toscano fra l'Arno e la Magra," *Atti X Congr. Geografico Italiano*, I, Milano, 1927.

coste italiane. Così, per ricordare solo alcune zone costiere, la spiaggia è in forte ritiro dal 1900 circa a Chiàvari nel Golfo Ligure, dal 1890 alla foce d' Arno, dal 1905 nel Golfo di Giòia (Calàbria); si può calcolare in stadio di arresto alle foci del Po dal 1904, soprattutto nei lobi del Po della Pila e di quello di Tolle, e dal 1914 la spiaggia si ritira anche alla foce di Piave Nuova (estuario veneto).

Sembra quindi che gran parte delle spiagge italiane, in mari anche diversi, si trovino in uno di quei stadi di arresto di accrescimento, la cui intermittenza sarebbe una delle caratteristiche costruttive delle spiaggie a delta[1].

Quanto alle ragioni di tale stadio di arresto, esse sono probabilmente assai varie e interferentesi fra loro, dovute sia a variazioni d' ambiente, per cause fisiche, sia all' attività passata e presente dell' uomo. Di particolare importanza scientifica e pratica risulterebbe quindi il riscontro di un possibile sincronismo di cicli successivi di queste fasi di sviluppo dei litorali sabbiosi, ma troppo poche sono oggi ancora le ricerche metodiche, anche nella sola Italia, per potere intravedere un andamento periodico di esse. Queste ricerche invece presenterebbero speciale valore e probabilità di più sicuri risultati, se iniziate e proseguite, con metodo comune e con raffronti comparativi, su litorali diversi bensì, ma che presentino simili o paragonabili condizioni fisiche e di civiltà, come è appunto il caso delle coste del bacino Mediterraneo.

Chè se volessimo invece estenderle subito a mari e paesi diversi, le troppo varie condizioni talassografiche (correnti, maree, venti dominanti, ecc.) e il diverso sviluppo durante i secoli dell' azione umana sul regime idraulico dei vari corsi d' acqua—di cui mancherebbero probabilmente molte notizie storiche (colonizzazione e lavoro del suolo superficiale del bacino imbrifero, arginatura e deviazione dei corsi d' acqua, conservazione del regime lagunare o colmamento per bonifica, ecc.)—porterebbe a deduzioni forse non confrontabili fra loro.

Invece gli intenti che una tale ricerca metodica si proporrebbe in un bacino limitato, come il Mediterraneo, potrebbero essere così definiti:

(*a*) Le variazioni di estensione di una costa bassa, che si presentano assai notevoli in senso orizzontale, potrebbero porre in evidenza anche piccole differenze di livello delle coste alte contermini a cui si appoggia, differenze dovute a fenomeni bradisismici locali, come ha

[1] Marinelli, O., "Le foci del Po secondo le ricognizioni aeree del 1924," *L'Universo*, VI, pp. 347–54, Firenze, 1925.

sostenuto recentemente anche il Gregory[1]. Tali ricerche potrebbero collegarsi agli studi della speciale "Commissione internazionale sui terrazzi pliocenici e pleistocenici[2]." Le osservazioni sulle variazioni passate delle spiaggie basse, potrebbero illuminare invece sulla possibile diversità del livello marino nelle acque costiere. E ciò, sia in relazione dell' idea sostenuta dal De Marchi[3], che nel passato un maggior livello delle acque corrispondesse al ritiro dell' espansione glaciale quaternaria; ovvero che le variazioni attuali del livello medio costiero dei nostri mari siano legate piuttosto alle stesse modificazioni delle linee di spiaggia, come sostiene il Douglas per alcune coste americane[4]; ovvero dipendano da movimenti eustatici, in relazione a variate condizioni d' equilibrio del geoide, come nella teoria del Denza, oppure a movimenti di masse continentali, come nell' ipotesi del Wegener.

(*b*) D' indole anche pratica sarebbe il controllo, mediante queste ricerche, della influenza di variazione del regime idrografico dei diversi corsi d' acqua, e conseguenti trasporti di torbide fluviali, sull' andamento della linea di spiaggia. E ciò, sia per variazioni climatiche, soprattutto nella quantità e regime delle precipitazioni, come furono studiate per l' Arno[5], sia per l' azione dei lavori di regolarizzazione del bacino imbrifero, che influendo sul regime idrografico di un determinato fiume si riflettono anche sullo sviluppo del suo delta, tenuto conto della costipazione dei materiali minuti litorali per assestamento naturale o per prosciugamento artificiale della zona costiera.

(*c*) D' importanza storica sarebbe poi la ricerca delle antiche condizioni fisiche dei territori litorali alluvionali, che sappiamo essere stati sede di antichissime popolazioni[6], in tutto il nostro bacino Mediterraneo, e ciò in ordine all' attività e modi di vita di quei popoli primitivi, come per controllo ed interpretazione di dati archeologici, tradizionali e documentari.

Sarebbe quindi desiderabile che l' Unione Geografica Internazionale presentasse il tema, di cui è oggetto questa comunicazione, allo studio dei singoli Comitati Nazionali, perchè essi ne preparassero l' attua-

[1] Gregory, J. W., *Raised Beaches and Variations of Sea-Level*; see pp. 157–8.

[2] Union Géographique Internationale, *Rapport de la Commission des terrasses Pliocènes et Pléistocènes*, Oxford, 1928.

[3] De Marchi, L., "Variazioni del livello dell' Adriatico in corrispondenza con le espansioni glaciali," *Atti Acc. Scient. Veneto-Trentina-Istriana*, XII–XIII, 1922.

[4] Douglas, W. J., "Les Variations du niveau de la mer et les modifications de la ligne de rivage," *Annales de Géogr.* XXXVII, 205 n., Paris, 1928.

[5] Toniolo, A. R., "Sulle variazioni di spiaggia a foce d' Arno, dalla fine del sec. XVIII ai nostri giorni," *Studio Storico-fisiografico*, Pisa, 1916.

[6] Baratta, M., "Spina," *La Geografia*, anno XIII, fasc. 2–3, Novara, 1925.

zione pratica, onde al prossimo Congresso Internazionale di Parigi del 1931 potesse essere nominata una Commissione internazionale per lo studio delle Variazioni dei litorali sabbiosi nel bacino Mediterraneo, con ben determinati scopi d' indagine, precisa designazione e ripartizione delle zone di studio e comuni metodi di ricerca.

SUR L'EXPLORATION SCIENTIFIQUE DE LA MER ROUGE

COM. LORENZO MANCINI

C'est de l'époque où l'Italie a établi une colonie sur la Mer Rouge que date la contribution que les Italiens apportèrent aux études pour l'exploration de cette mer. La tâche particulièrement confiée à notre Marine fut, dès le commencement, celle des recherches hydrographiques et nautiques. Successivement le navire hydrographique *Ammiraglio Magnaghi* (Mer Rouge, septembre 1923–mai 1924) eut la charge d'une croisière ayant à la fois caractère hydrographique et océanographique. Ayant l'honneur d'être délégué à participer aux séances du Congrès Géographique International je me flatte de présenter aux actes de cette Section les publications qui concernent dans une forme extensive les travaux effectués par notre Service Hydrographique.

La valeur des études concernant la Mer Rouge a été signalée à l'Union Géographique Internationale au moyen d'un vœu formulé par le Conseil International des Recherches au Congrès Géographique International du Caire en 1924 exprimé à peu près comme il suit: "Vu les nombreux avantages qui résulteraient non seulement à l'égard de l'économie de la pêche et de la navigation en outre des travaux publics maritimes et des industries qui dérivent de l'exploitation de la mer, mais autant pour ce qui concerne la science géographique en général et l'exploration scientifique de la Mer Rouge, le Congrès Géographique International du Caire appuie le vœu de la Section Océanographique de l'Union Géodésique et Géophysique en le recommandant au Conseil International des Recherches."

Il est superflu de mentionner les travaux hydrographiques qui ont été exécutés par la Marine Italienne dans la Mer Rouge dès le commencement de l'occupation de l'Érythrée. Ils comprennent les levées des chenaux maritimes, des archipels et des mouillages importants de cette partie de la côte africaine concernant la Colonie. Ils ont

ainsi permis, de la part de l'Institut Hydrographique, la publication de neuf cartes marines à différentes échelles, qui ont contribué sans doute, à augmenter, avec force détails, la grande valeur des connaissances géographiques, que, grâce au mérite de ses vaillants navigateurs, l'Amirauté Anglaise nous a présentées dans ses importantes cartes marines No. 8 *a*, *b*, *c*, *d*, *e*, qui reproduisent les côtes de la Mer Rouge depuis le canal de Suez jusqu'à Bab el Mandeb.

Les publications que j'ai l'honneur de présenter à cette Section du Congrès comprennent les volumes des *Annales Hydrographiques*, No. 11 et No. 11 *bis*, ainsi qu'un bref résumé intitulé: "Esplorazione scientifica del Mar Rosso." Ce résumé comprend des communications dont la forme, autant que possible synthétique, est rédigée par des professeurs dont une partie n'est pas représentée au Congrès, mais qui ont pourtant participé aux recherches et à la discussion des résultats obtenus.

Je voudrais fixer l'attention sur les opérations, qui ont un caractère spécialement océanographique et qui ont été exécutées en maintes circonstances. On doit à cet égard rappeler la croisière de la *Gazelle*, du *Challenger*, du Dr Lenz en 1826, de Bouquet de la Grye en 1874, du Dr Liersher en 1881. Les données qu'on a pu obtenir dans les dites croisières sont pourtant limitées aux couches superficielles de la mer. On doit excepter les travaux du Capitaine Pullen en 1856 et de l'Amiral Makaroff en 1889 qui ont accompli des recherches dont le nombre est limité dans les régions pélagiques et profondes. Ce fut à l'époque (hivers 1895–6 et 1897–8) que le navire autrichien *Pola* accomplit des observations continuelles et systématiques dans les régions superficielles, pélagiques et profondes, dans tout le bassin de la Mer Rouge et du canal de Suez, au but d'obtenir une exploration particulièrement intéressante, jamais entreprise auparavant.

Dans la même année 1898 le navire de la Marine Anglaise *Stork*, commandé par le Capitaine Gedge, a achevé des mesurages réguliers des courants dans le détroit de Bab el Mandeb, mesurages qui, à cette époque, représentaient les travaux plus positifs à l'égard de l'étude des courants de la Mer Rouge qu'on avait exécutés dans cette importante région marine. Les deux croisières du *Pola* et les données récoltées par le Commandant Gedge du *Stork* ont fourni les éléments principaux pour la préparation du programme des études que la Marine Italienne devisa d'entreprendre en 1923–4.

La campagne du *Magnaghi*, dirigée par le Capitaine de Vaisseau Leopoldo Novaro, a produit des résultats très appréciés soit à l'égard des nouveaux travaux hydrographiques, soit à l'égard d'un important

groupe de recherches scientifiques, ayant rapport à l'océanographie physique et biologique, qui permit, pour l'étude des courants et des marées, une profonde analyse des nombreuses données récoltées dans plusieurs parties de la mer, surtout dans la partie méridionale et dans le Golfe de Suez.

La petite canonnière *Général Arimondi* coopéra admirablement avec le navire hydrographique dans son importante tâche; et son concours a été très important lorsque le navire mouilla pendant la durée de 15 jours continuels dans le détroit de Bab el Mandeb sur une profondeur de 170 m. environ.

Le *Général Arimondi* supporta dans cette occasion, pendant une longue semaine, le désarroi d'un vent très fort et d'une mer orageuse qui augmentaient particulièrement les difficultés de sa tâche, pénible pendant la nuit, vu que cette position est assez fréquentée par les navires de la ligne des Indes, entre la Méditerranée et le Golfe d'Aden.

Malgré les observations méthodiques qui avaient été toujours accomplies, il a été permis de préciser la manière dont s'effectue le changement des eaux entre l'Océan Indien et la Mer Rouge; détermination d'une valeur fondamentale qu'on n'avait jamais pu réaliser à cause des difficultés techniques de l'entreprise.

Le professeur Francesco Vercelli, directeur de l'Institut Géophysique de Trieste, qui était embarqué sur le *Magnaghi*, étant chargé de tous les travaux physicochimiques accomplis pendant cette campagne, a publié dans le 11^{me} volume des *Annales* les résultats de ses études qui concernent particulièrement les mouvements dynamiques des eaux.

Il a en effet donné une solution que l'on peut dire complète au problème des courants de marée à Bab el Mandeb et dans la partie sud de la Mer Rouge; il a fait de même des déductions intéressantes sur les courants de dérive dans l'hiver; il a calculé les relations harmoniques du régime des marées sur toute la Mer Rouge et dans le Golfe de Suez, ainsi que le régime des courants tant de marée que progressif pendant la saison d'hiver; il a donné une explication nouvelle du phénomène des courants transversaux qui, comme l'on sait, avait donné sujet dans le temps à plusieurs discussions dans l'intérêt des problèmes nautiques. Le professeur Mario Picotti, chimiste du même Institut Géophysique de Trieste, ayant participé à cette même croisière, nous donne dans le volume 11^{me} *bis* des *Annales* les tables des analyses chlorométriques et des données thermiques et de salinité.

Il n'est guère possible de résumer dans une communication

synthétique les résultats détaillés obtenus en étudiant le régime tant des courants que des marées.

Toutefois je pense qu'on pourra toucher très rapidement les travaux plus importants qui témoignent des résultats obtenus.

(1) Les courants de la marée pour le détroit principal de Bab el Mandeb ont été calculés et recueillis dans douze tables mensuelles.

Les observations pour en déterminer le régime furent effectuées dans les trois stations principales, une près de la côte de Dankalie, les autres dans les deux détroits de Bab el Mandeb; et de celles-ci celle du plus grand des détroits a eu, comme on a déjà dit, la durée de 15 jours continuels.

Les régistrations de la température et les échantillons de l'eau ont été pris successivement à chaque station à la profondeur de 5, 10, 20, 50, 100, 130, 150 m.

Les valeurs que nous relevons par les tables, dûment calculées et combinées avec les valeurs du courant saisonnier de dérive, correspondent aux mêmes valeurs qui ont été mesurées dans les points d'observation et qui correspondent de même aux valeurs observées à Bab el Mandeb par le Capitaine Gedge du *Stork* en 1898.

(2) Le régime des courants dans la partie méridionale de la Mer Rouge a été étudié en concentrant à ce but les recherches sur quatre lignes principales transversales, à partir de Perim jusqu'au 17^{me} parallèle. On a pu ainsi préciser le cours et la valeur des courants proches de la côte sud des deux continents, et particulièrement dans les chenaux de Massaua.

(3) On a calculé les tables des marées dans toute la Mer Rouge et le Golfe de Suez moyennant les données relevées par 13 séries d'observations maréographiques avec des instruments dont disposait le *Magnaghi* et qui étaient placés sur le littoral, pendant des périodes suffisantes et comprises entre le minimum d'un mois et le maximum de six mois. Aux constantes harmoniques de Suez et de Aden qui étaient naturellement déjà connues, on a pu ajouter ainsi 11 séries tout à fait originales pour chaque place choisie sur les deux côtes de la mer: Tor, Koseir, Ashrafi, Shadwan, Ras Charib, Zafarana, Gidda, Port-Sudan, Massaua, Kamaran, Assab, Suez et Perim.

Ces marées qui présentent des aspects fort caractéristiques prouvent la présence de trois lignes nodales dans la Mer Rouge pour la marée partielle, semi-diurne lunaire, dans les localités suivantes: au Sud des bancs de Tor (partie méridionale du Golfe de Suez); sur une transversale proche de Port-Sudan; sur une transversale entre Assab et Perim.

Ces lignes partagent la mer en quatre zones et dans chacune d'elles les mouvements dans tout l'espace du bassin de la mer ou les marées semi-diurnes forment la quasi-totalité des courants de marée.

Ayant ainsi touché rapidement le sujet des travaux que la croisière du *Magnaghi* nous permit d'exécuter à l'égard des marées, il nous faut renvoyer ceux qui s'intéressent à la matière aux conclusions détaillées qui sont exposées dans les *Annales Hydrographiques* et qui donnent tous les détails sur les anomalies qui se vérifient dans les différentes parties du bassin et qui prouvent aussi les différences entre les mouvements de la Mer Rouge et ceux de l'Océan Indien non moins que la prévalence entre les courants de marée et les courants de dérive ou progressifs.

(4) Les observations conduites dans la croisière sont d'un intérêt non indifférent pour éclaircir quelques affirmations des routiers et des cartes marines dont l'expression douteuse à l'égard des courants transversaux augmentent les difficultés de la navigation. Les cartes marines, en effet, rappellent souvent aux navigateurs de se méfier de l'action imprécise des courants transversaux avec la locution suivante: "Strong currents occasionally set across the Red Sea; the mariner should therefore give a good berth to all outlying reefs and shoals" —locution qui vient d'être augmentée de détails qui sont confirmés dans toutes les éditions des portulans de l'Amirauté Anglaise depuis 1883 jusqu'à 1921. On dit, en effet, que les différences sensibles constatées entre la position effective du navire et celle déduite au moyen des observations astronomiques atteignent une valeur jusqu'à 20 milles. Les différentes affirmations à l'égard des phénomènes signalés qui n'avaient pas de causes apparentes, dirigèrent les études des savants vers des discussions de différente nature et on arriva même à douter de la possibilité de leur existence.

On a ainsi parlé des influences que les perturbations magnétiques pouvaient avoir sur les compas de navires en fer; et on a exposé une théorie assez intéressante sur des valeurs exceptionnelles de la réfraction dans la Mer Rouge, par laquelle les valeurs de la dépression de l'horizon seraient soumises à des variations notables en des conditions fort différentes entre la température superficielle de la mer et les couches d'air plus proches.

C'est de la croisière du *Magnaghi* que dépend le nouvel envisagement de cette question, et on a pu de cette façon confirmer l'existence des courants transversaux qui paraissait douteuse. En effet les observations poursuivies dans le Golfe de Suez et dans la partie méridionale de la Mer Rouge prouveraient qu'il s'agit des courants de marée

variables dans la même place en direction et en force dans une période de presque six heures. Ainsi le courant change graduellement tant à l'égard de la vitesse que pour ce qui concerne la direction et l'on pourrait même affirmer que ces variations suivent nettement la loi des rayons d'une ellipse allongée ayant son axe majeur dans la direction longitudinale du bassin.

Je voudrais encore ajouter quelques détails à propos des études qui ont été développées dans la même croisière. Le Capitaine de Corvette Cugia a calculé la gravité, relativement à la station fondamentale de Gênes, à Suez, Assab, Asmara, Massaua, Aden. Les valeurs obtenues en 1923–4 présentent des anomalies plutôt sensibles, comparées aux valeurs calculées par le lieutenant Triulzi à bord du *Pola*. Le Commandant Cugia a mesuré dans les mêmes endroits les valeurs des éléments magnétiques en les rapportant encore aux données présentées par le *Pola* et aussi par le professeur Palazzo dans une de ses excursions scientifiques en Érythrée.

Vercelli (*Annales*, vol. 11) a présenté un mémoire sur l'optique marine, et une discussion sur les valeurs qui ont été jusqu'à présent admises au sujet de l'évaporation annuelle dans la Mer Rouge. Le prof. Luigi Sanze, biologue en chef de l'Institut de Biologie Marine de Messine, a récolté un matériel abondant pour ses études biologiques; matériel qui ayant été distribué aux biologues italiens spécialisés a engendré toute une moisson de mémoires dont une petite partie seulement a été insérée dans le vol. 11 *bis* que nous avons ici présenté.

Les Ministères de l'Économie Nationale et des Colonies ont organisé des croisières exploratives afin d'étudier les moyens plus pratiques pour obtenir, au profit des sociétés industrielles, une exploitation rationnelle des produits de la Mer Rouge.

Les résultats des susdites croisières, non moins que l'expérience pratique des sociétés industrielles, n'ont présentement pu nous laisser d'espoir effectif d'un résultat satisfaisant pour ce qui concerne l'industrie de la pêche. En exceptant les zones proches des centres peuplés (guère fréquents sur ces côtes) qui peuvent être desservies par des lignes de transport (ainsi qu'il en est des endroits proches de la ville de Suez) il n'est guère possible de prévoir actuellement, sur toute l'étendue de la Mer Rouge, une exploitation régulière des produits de la pêche. Les conditions toutes particulières du climat ainsi que la difficulté de vendre les produits sur place ou de se procurer les moyens nécessaires à leur conservation et utilisation, empêchent d'activer une industrie qui représenterait une valeur remarquable.

Le navire hydrographique *Magnaghi* sera nouvellement destiné

dans le prochain automne à effectuer une levée hydrographique dans l'archipel des Daalak; et les travaux auront lieu entre le 1er novembre 1928 et fin mai 1929. Le Ministère de la Marine a l'intention de joindre au commandement du navire hydrographique une seconde unité de moindres dimensions pour effectuer des observations uniquement océanographiques dirigées à la détermination des courants de dérive, dans ces parties de la Mer Rouge qui n'ont pas encore été étudiées. On devrait en outre relier cette seconde série d'observations à celle de la croisière précédente et l'enrichir de recherches intéressantes d'optique marine autant que d'études sur l'évaporation.

Les récoltes biologiques n'y seront de même pas délaissées et le Ministère accordera, nous l'espérons, que deux docteurs spécialisés en sciences prennent part à la croisière pour effectuer des récoltes sur la végétation marine non moins que sur la nature et la morphologie des terrains en émersion dans les archipels et au bord des continents. Je dois me rapporter à ce sujet aux communications des prof. Negri et Stefanini et à celles qui concernent les études sur la biologie marine des professeurs Caroli, Santucci, Issel, d'Ancona, Sanzo, Colosi (Esplorazione scientifica del Mar Rosso).

En résumant, on doit observer que la Mer Rouge, qui s'étend comme une énorme lame d'eau entre deux continents, nous présente une position géographique très particulière pour les études scientifiques qui doivent se rapporter aux recherches sur les côtes limitrophes des continents ainsi que sur la mer.

Quoique laissant aux recherches, qui doivent s'accomplir à la mer, toute liberté d'exécution, nécessaire aux observations océanographiques, on devrait, à mon avis, entreprendre des observations à la mer et sur les côtes, en ce qui concerne:

(*a*) La morphologie et les caractères géologiques des côtes, des continents et des îles dans les nombreux archipels.

(*b*) La détermination des conditions météorologiques pendant toute l'année en demandant le concours des bateaux qui, traversant la Mer Rouge, peuvent fournir dans la saison d'été des données précieuses.

(*c*) Les conditions biologiques en rapport aux constructions des madrépores (Colosi) et aux études sur le nannoplancton proposées par le professeur Issel.

(*d*) Les conditions de la végétation marine au large et au bord de la mer.

(*e*) Continuer les études des mesurages pour évaluer l'évaporation annuelle autant que les observations de réfraction pour confirmer

les données jadis calculées par le Commandant Koss dans la croisière du navire autrichien *Pola*.

(*f*) Intensifier les mesurages de gravité sur la terre ferme et à la mer de même que les mesures de magnétisme terrestre dans toutes les zones où les données ne sont pas assez exactement connues.

(*g*) Calculer avec les méthodes de la Géodésie Astronomique le plus grand nombre possible de positions astronomiques, particulièrement dans les îles des archipels dont la position est éloignée des côtes continentales.

(*h*) Entreprendre enfin des mesurages optiques dans le milieu marin à l'aide d'instruments perfectionnés par rapport à ceux que l'on a dû adopter dans les campagnes du *Magnaghi* et du *Pola*. Tels instruments perfectionnés doivent avoir eu récemment à bord du *Météor* une application satisfaisante. Les recherches sur la pénétration des rayons dans les eaux de la Mer Rouge peuvent y être accomplies là-bas à une grande profondeur, dans les zones abyssales centrales, et lorsque le soleil se trouve au zénith, l'atmosphère étant limpide, il se détermine une situation particulièrement avantageuse.

SOME STAGES IN THE EVOLUTION OF THE RIVER NILE

DR M. AWAD

Considering the Equator and the 20th meridian of East Longitude as dividing Africa into four unequal parts, the north-eastern portion may be considered as almost the exclusive sphere of the River Nile. Of all the features of the physical geography of East and North Africa, the Nile is the most conspicuous and the most persistent. Though not the longest river in the world, the Nile joins areas much farther apart than is the case with any other river. Its most southerly headwaters lying just beyond the 3rd parallel south of the Equator, and its mouths beyond the 31st northern parallel, the river thus connects points which are separated by over 34° of latitude. It is able to do so because of the remarkable manner in which it flows almost persistently from south to north. In places, it is true, the river deviates from a strictly northerly course. At one point it may flow due east, at another it even assumes a south-westerly trend. But it soon resumes its northerly flow, which, considering the river as a whole, is so scrupulously maintained that both its Equatorial sources and its mouths lie almost upon the same meridians of longitude. In this respect the Nile is in sharp contrast with the other great rivers of Africa, which tend to run in an

east–west direction; a tendency which, according to some authorities, is in conformity with such topographic conditions as existed in Mesozoic times[1]. While it is inconceivable that the old river systems of Africa have remained uninfluenced by the great tectonic changes which the continent has undergone since Mesozoic times, it seems nevertheless true that the Nile contains perhaps far fewer features of great antiquity than any other African stream of any importance. The very land through which the Nile flows contains some of the most recent geological formations in a continent whose main structure is indicative of great antiquity. The Lower Nile runs through relatively recent formations, ranging from the Nubian sandstone in the south to the Pliocene, Pleistocene and recent deposits as it approaches the Mediterranean, while the Upper Nile runs very largely through those archaean masses of gneiss and schist, and other metamorphic rocks, for which Central Africa is notable.

It may thus at first seem quite simple to consider the evolution of the Nile as having progressed steadily in accordance with the relative age of the various portions of the Nile Basin, the more southerly part of the river having come first into existence; while the northern sections were formed along those lands which gradually emerged after the contraction of the ancient sea of Tethys. Such a picture of the evolution of the Nile will, however, appear obviously a mistaken one when we remember that the great central plateau of Africa, despite its antiquity, has been, in quite recent geological times, subject to violent tectonic changes, which have caused such corresponding alterations in the relief features of the continent as must have influenced the pre-existing drainage systems. The activity of some volcanoes in the Mfumbiro range, and the frequent occurrence of earthquakes in such stations as Rejaf, on the Upper Nile, are reminders that such changes have not only occurred at a recent date, but are by no means yet completely at an end. The Nile, in some of its upper reaches runs through stretches, whose juvenile character stands in sharp contrast to the general antiquity of the land through which it flows. It is thus evident that no simple conception as to the evolution of the Nile can be formed, arguing merely from the relative age of the strata of which its basin is composed. Nor are conditions with regard to the Lower Nile more susceptible of simple analysis. One of the problems of the physiography of the Nile is to account for the apparently inexplicable course which the river follows between Khartoum and Aswan, making a double bend through Nubia, and

[1] Cp. Gregory, *G.J.* vol. LVI, 1920, p. 376.

running, in places, in a direction almost exactly opposed to that which it generally pursues. Further, in this particular section the river displays all signs of a very immature stream. It is little wonder that some eminent observers have argued that the present Nile has come into existence only during the diluvial period, that is, towards the end of the time which is described in Europe as the Ice Age.

The Nile obviously possesses features of such a striking and unusual character as must call for special explanation, and must inevitably lead to some reference to the earlier history of the river, however difficult such a discussion may be, and—considering our incomplete knowledge of the geology and topography of a large part of the Nile Basin—however tentative and at times even extravagant may be the conclusions attained.

A discussion of the early history of a river, even when our knowledge as to the relief and geology of its basin and of the neighbouring countries is more complete than is the case with the Nile Basin, is never an easy thing. This may be realized by reference to a recent article on the history of the Thames by Prof. J. W. Gregory (*G.J.* LXX, 1927). While some writers like Lyons have been reluctant to arrive at any definite conclusions with regard to the evolution of the Nile, several others have ventured to offer some bold suggestions on this question, sometimes rather in excess of what can be warranted by the scanty evidence. There are three somewhat different angles from which the question of the Nile can be and has been approached.

The first, the geological standpoint, deals with the relation of the river to deposits of a fluviatile character which may be found either close to the river or at some distance from it; and attempts to trace the history of the river back into former geological epochs through the evidence of fossils and old deposits.

The second aspect, which is not unrelated to the first and which we may call the biological standpoint, is that which seeks to prove the earlier history of the Nile and its relation to other river systems, by an examination of the fresh water fauna of the rivers and lakes of Africa and of such neighbouring lands as Syria and Palestine. The Nile is then considered as having been connected with such systems as Lake Chad or the Jordan because its fishes bear a strong similarity to those of the said systems.

Thirdly, we may approach the question of the Nile from a purely physiographic standpoint by attempting to study the nature of the river in its various sections; and, since it often displays a definite departure from conditions of normal development, it may be useful

to try and find out whether its earlier history may not help in explaining these peculiarities.

In most discussions of the evolution of the Nile, all these points are usually taken into consideration, though often one set of factors receives greater weight than the others. While in the present study we are chiefly concerned with the physiographical aspects of the question, we may profitably begin by a consideration of the principal theories advanced in the order given above.

I

Edward Hull[1] was one of the first geologists to tackle the question of the early history of the Nile. The main theme which he tried to discuss was the question of the former volume of the Nile, which he considered to have been at one time much larger than it is at present. He bases his conclusions first upon the existence of higher terraces of fluvial deposits close to the banks of the river; and secondly, upon the altitude of some dry channels, through which, he argued, the Nile must have flowed at one time. He notes the presence of large sheets of gravel which extend in Nubia for a length of 7 or 8 miles along the Nile bank at Dabeira, 8 miles north of Wadi Halfa, at 100 ft. above the present Nile floods, and containing shells of a recent date. Other similar terraces, though not perhaps so elevated as those in Nubia, he recorded as noticeable at Girga, in the plain of Thebes, at El Kab, on the right bank and at Kom Ombo; and at other places above the first cataract.

His other evidence rests on the presence of old, now dry channels, and he makes special mention of one at Kom Ombo, and two others at Aswan. The latter two channels, which connect Aswan and Shallal and run east of the present Nile channel, he rightly considers to have been at one time channels of the River Nile, which the Nile has abandoned after its level had been lowered owing, according to Hull, to its diminished volume. Nor was he in doubt as to the cause of this diminished volume. It was due to the drying up of tributaries consequent upon a diminished rainfall. In the Pluvial[2] period Egypt was subject to climatic conditions such as are now prevailing in Europe. He makes special note of the dry valleys of Wadi Sonnur opposite Beni Suef, Wadi Tarfa north of Miniya, Wadi Asyut opposite the

[1] *Q.J.G.S.* 1896.

[2] This term is employed by nearly all geologists with reference to Egypt, North Africa and Syria, in pleistocene times, and while some prefer to confine it to the period corresponding to the Ice Age in Europe, others have used the term to include all the period just before the close of the pliocene to the end of the pleistocene.

town of the same name, Wadi Qusab opposite Girga, Wadi Qena opposite Qena, and Wadi Abu Wasil opposite Luxor, all of which lie in the eastern desert of Egypt, and which, if containing any water, would have discharged into the River Nile. There are indeed innumerable other dry valleys, particularly in the eastern desert, which, it is reasonable to argue, could never have been excavated under the climatic conditions now prevailing. But to say that Egypt was subject to a climate similar to that of Europe would hardly throw much light on the problem. It is necessary to mention which part of Europe is meant.

It may at present be considered quite comprehensible that at a time when parts of Europe were experiencing climatic conditions of an arctic character, there was at the same time a general shifting of the climatic belts a little further to the South[1], so that climatic conditions in North Africa, and at any rate in Egypt might reasonably bear some analogy to those now prevailing in *Southern* Europe. Upper Egypt could at the most have had but a "Mediterranean" sort of climate, with a winter rainfall, which, owing to the geographical position of Upper Egypt could not have been very abundant. During that "pluvial" period, the present dry valleys of the eastern desert, would, for a part of the year, at any rate, have contained a certain amount of water, and their channels, which at places are of considerable depths, would have been excavated mainly during the same period.

But while admitting that the lower Nile during the Pluvial period might have received a great number of tributaries, which for a few months in the year added to its water supply, it does not necessarily follow that the level of the Nile stood much higher than at present, as a result of these additional contributions. It is necessary to remember that the time of the Nile flood, and the time when these tributaries added their contributions do not coincide. The rainfall, in what is now the Eastern desert of Egypt, could not have commenced until the Nile flood-level had begun to diminish, and the effect of the additional waters supplied by those tributaries would seem to have been merely to maintain the flood-level for a little longer, without actually increasing the volume of the river. It is even argued by some authorities[2] that the Nile flood during the Quaternary must have been far below the present one, because Abyssinia was one of the few regions in the world which during the Ice age was a relatively rain-

[1] Cf. C. E. P. Brooks, *Climate throughout the Ages*, esp. pp. 314–7.
[2] Cf. Brooks, *op. cit.* p. 317 and Hume and Craig, "The Glacial Period and Climatic Changes in North-East Africa," *Rep. Brit. Ass.* 1911, p. 382.

less area, and the Nile was thus deprived of the major sources of its flood supply. Two writers, Hume and Craig, even believed that the Nile did not then even come into existence; but in this view they were probably still influenced by Blanckenhorn's earlier views, some of which he himself subsequently abandoned.

But even while the existence of the Nile as early as the Pluvial period may be considered as quite probable, it does not seem necessary that its volume was greater than it is now. The evidence of the now dry valleys of Egypt certainly does not seem a sufficiently strong basis for such a conclusion.

The higher Pleistocene terraces near the present bank of the Nile, while undoubtedly proving that the level of the Nile was higher, may be explained as due to the presence of an obstruction, or a series of obstructions in the river, the removal of which caused a subsequent fall in the level of the river. It is at present certain that such, in one instance at least, was undoubtedly the case. Between the Second and Third Cataracts of the Nile, the temple of Semna, discovered by Lepsius in 1842, contained inscriptions which seem to indicate that the level of the Nile flood, some 4200 years ago, was 24 ft. higher than the average level of the Nile flood at the present time. The change of level according to Dr Ball[1], who made a special examination of the district, was due to the removal by erosion of an intrusive barrier of harder rocks. Dr Ball has also studied the region of the First (Aswan) Cataract, and is convinced that the Nile at one time certainly ran in the now dry channel to the east of the Nile, in which at present the railway runs. He considers, however, that the cause of the change in the course of the river, was due to earth movements, which provided the Nile with the deeper channel in which it runs at present[2].

It is nevertheless quite conceivable and perhaps not unnatural that the level of the Nile was higher in Pleistocene times. The river flowed in the first instance over strata whose angle of dip was greater than the present slope of the river. It is reasonable to suppose that in the early stages of its development the slope of the river was greater than it is at present, and was more in accordance with the general slope of the strata. The erosive power of the river at that time was, consequently, greater than it is at present, and this by itself and especially when assisted by earth movements would account for the deepening of the bed and the lowering of the level of the stream. Higher terraces and higher dry channels are not in themselves an adequate

[1] "The Semna Cataract," *Q.J.G.S.* 1903.

[2] Cf. *First or Aswan Cataract*, Cairo, 1907, pp. 100 *sqq.*

proof of the greater volume of the river in the Pluvial period, even when we do not accept in its entirety the theory that during that time the Lower Nile did not draw from the Abyssinian Highlands anything like the amount it receives at present.

With regard to the theory that Abyssinia was much drier in the Pluvial period, *i.e.* when Egypt itself was much more humid than it is now, it is necessary to keep an open mind. The theory is closely linked with those advanced in explanation of Pleistocene glaciation. It considers not only that there was a displacement of climatic belts towards the south, but that owing to the presence of a large ice-sheet over the Himalayas, whose influence raised the pressure over Central Asia, the north-east monsoons prevailed throughout the year, while the south-west monsoons were very weak, if they at all existed. The rainfall over Abyssinia was consequently very small and the Blue Nile failed to reach Egypt and simply ended in the desert, much in the same manner as the Mareb to-day fails to reach the Atbara. The theory maintains that the rainfall in Abyssinia became heavy and the Blue Nile began to assume its present shape only during the period corresponding with the Mindel-Riss interglacial[1], thus giving the Nile a very short age indeed. The theory is supposed to receive corroboration from the fact that the deposits of Nile mud in some parts of Upper Egypt do not reach more than about 40 ft. in thickness, a considerable part of which is known to have been deposited within historic times. It is further attempted to give a date to the existence of the Nile by arguing that, if the rate of deposition has been uniform, only about 14,000 years are required for the accumulation of the existing deposits of Nile mud in Upper Egypt.

The theory, however, which gives the Nile such an exceedingly short history, does not seem to harmonize with some undeniable truths of the physiography of the river. After all, the question as to the climate of Abyssinia in the Quaternary period is very largely hypothetical. But it is a well-known fact that the headwaters of the Blue Nile in Abyssinia consist of deep ravines, "which are often several kilometres broad and more than one thousand metres deep[2]," and are cut through the hard basalt and the underlying sandstone and metamorphic rocks; and it is difficult to imagine that they have been excavated merely since the Riss, and during a period measurable in thousands of years.

[1] Cf. Hume and Craig, *op. cit.* p. 383; and Brooks, *The Evolution of Climate*, pp. 73 *sqq.*

[2] Willcocks and Craig, *Egyptian Irrigation*, 1913, pp. 280 *sqq.*

Nor does the argument with regard to the depth of the deposits in Upper Egypt, when closely examined, carry much more weight. It is possible that local conditions might affect the extent of the deposition that can possibly take place; and it is at any rate certain that in its earliest history the Nile could not have deposited its silt in Upper Egypt at the same rate as it is doing at present. In its early stages the river ran over lands whose slope was greater than the present slope of the river. Over these formations the Nile ran faster and deposited less than it does at present. It had, further, to excavate its present wide and fairly deep channel, which, even if we consider it to be the result of faulting, must have required a certain amount of excavation. When we come further to consider the thickness of the deposits in the Delta, the attitude as to the short history of the river becomes untenable. It is easy to see that the deposits in the Delta are a far better measure of age than those of Upper Egypt, because the former were deposited in a fairly deep gulf of the sea. The thickness of the Delta deposits have been measured by borings which were carried out to ascertain how deep was the rock foundation on which they lay. Such borings failed to reach any rocks at all down to a depth of about 350 ft.[1] It is true that the deposits do not consist entirely of Nile mud, but as is natural with the normal sequence of alluvial deposition, the lowest layers, deposited during the early career of the river, were found to contain gravels and sands[2].

Blanckenhorn was one of the first geologists to attribute to the Nile as it now exists a very short history. In his earliest works on the subject he thought the Nile Valley did not exist until the Diluvial (late Glacial) period, just about the same time as the appearance of man in Egypt. Later on, however, he had to modify his views considerably, and to refer the existence of the Nile to the beginning of the Pleistocene, or even to the close of the Pliocene[3]. He sought, however, to trace the evolution of the Nile back into the middle Eocene, by connecting it with what he called its "great ancestor," *Ahnherr*, a large stream, which flowed to the west of the present Nile Valley, and which he called the Libyan "Ur-Nil." The existence of such a mighty river as early as the middle Eocene is indicated by the nature of the

[1] Cp. J. W. Judd, "Second Report on Nile Deposits," *Proc. R. S.* 1897.

[2] In that part relating to Egypt the "Report on Pliocene and Pleistocene Terraces" submitted to the Congress seems clearly to contradict the conception of the Nile as a very recent river. See Summary by Sandford and Arkell, p. 17.

[3] Cp. "Die Geschichte des Nilstroms," *Z. d. Ges. f. Erdkunde*, 1902; and "Neues zur Geologie," etc., *Z. d. deut. Geol. Ges.* 1910; also the new edition (1919) of his *Geologie Ägyptens*.

deposits, by the presence of fresh-water fauna and enormous fossil trees. At that time this so-called proto-Nile discharged at the north-west corner of Lake Qarun into a Mediterranean which extended much further to the south than it does at present. The river continued to flow throughout the Oligocene and the Miocene, when it became an even mightier stream than it had been hitherto and when its mouths lay near the Wadi Natrun. Its existence is traced further into the beginning of the Pliocene, when it became exceedingly diminished in volume prior to its ultimate disappearance at the end of the Pliocene.

During the Upper Pliocene there was a temporary encroachment of the Mediterranean into what is now the Lower Nile Valley. By this time a series of fault-lines and fractures had come into existence, which were to determine the subsequent course of the River Nile in Egypt. Deposits of a saline character, which are found at considerable depths in the Lower Nile are to be referred to this transgression of the sea. Lagoon-fluviatile-marine fauna are found at the foot of the Moqattam, indicating that in this area there was in all probability the estuary of a river. In other words that the Nile had already come into existence. According to Blanckenhorn there was at this time, that is, at the close of the Pliocene and beginning of the Pleistocene, a temporary extension of the gulf of Suez, which, coinciding with the transgression of the Mediterranean, caused a temporary union of the two seas. (This, however, is not considered by Prof. Gregory to have been the case; and he shows by contrasting the fauna of the two seas that they could not have been joined together prior to the construction of the Suez Canal.)

Later, but still during the early phases of the Pluvial period (in other words about the time of the Günz Glacial age) the elevation of the Isthmus of Suez occurred, and the two seas became definitely separate, that is, if they were ever connected. Blanckenhorn considers that at this stage the Nile had a branch, which discharged into the Gulf of Suez. He further considers that the Nile Delta began to emerge about the same time. It is, however, difficult to say that the Delta has emerged at all, through any earth movements; the great depth of the deposits would seem to indicate that the gulf of the Mediterranean was simply silted up.

During the Günz-Mindel interglacial there was a short dry period in which there was but little erosion, and during which the sea retreated further to the north of Cairo. Blanckenhorn apparently attributes the first appearance of man in Egypt to this relatively dry

interval. He considers the time corresponding to the Mindel as the height of the Pluvial age in Egypt. The Nile then flowed at a much higher level, as is indicated by the higher terraces which Blanckenhorn attributed to this period. With the close of the Mindel came also the end of the Pluvial period in Egypt. Dry conditions began to prevail, and, even when glaciation was again prevailing during the Riss and Würm periods, there was no corresponding recurrence of pluvial conditions in Egypt. Slowly but persistently desert conditions began to set in until they were fully established at a time which Blanckenhorn estimates at about 20,000 years ago. Thus long before the beginning of the historic periods, Egypt was very much the same dry country that it has remained ever since.

Blanckenhorn's views, as modified by his later writings, have been on the whole acceptable to most geologists. Even the existence of his Ur-Nil is not seriously contested by other scholars, except that the exact course of the river as described by him must remain very largely hypothetical. Nor is it at all fortunate that he should have called it a proto-Nile. His Ur-Nil is merely a geological or a fossil stream, whose existence is attested by fluvial fossils and deposits, but which has disappeared in the course of geological time. The mere accident of its having been in nearly the same part of the continent of Africa, even if part of its waters were drawn from the same region as those of the present Nile, was no justification for confusing an existing river which has a history of its own with a geological river which had little to do with it. The Ur-Nil was certainly no ancestor or *Ahnherr* to the Nile.

Blanckenhorn's attempt was mainly concerned with the lower part of the Nile Valley. A more comprehensive account of the evolution of the Nile has been given by Theodor Arldt[1], who is a well-known authority on questions of palaeogeography. Arldt is also of opinion that the present Nile dates only from the Pliocene. From the middle Eocene onwards the sea began to retreat and the land to emerge, and this continued almost uninterruptedly throughout the Oligocene and Miocene. Syria during that time formed part of the continent of Africa, and of the "Ethiopian" zoological region. During the Pliocene the sea withdrew from Syria, which was then connected with Cyprus, the eastern Levant being then dry land. These last two points are of special interest, in view of the question of the similarity of the fauna of both the Nile and the Jordan system.

[1] "Zur Palaeogeographie des Nillandes, etc.," *Geol. Rundschau*, 1918, pp. 47 and 104.

In the middle of the Pliocene also, the sea began to encroach upon Egypt, which was flooded up to the site of Moghara, and did not retreat until the end of the Pliocene. Meanwhile, in Egypt and other neighbouring countries meridional fault-systems began to form; and through these, but *already in the Pliocene*, the Nile was deflected (!) from its western to its present course.

It will be noted that both Blanckenhorn and Arldt, as well as most German geologists, are of opinion that the Nile in Egypt runs through a system of fault-lines. This opinion is also adopted by Lyons and Gregory, but is emphatically rejected by Ball, who considers the Nile Valley in Egypt as due to erosion along a folded valley. Hume adopts a sort of compromise, and considers that the valley is due partly to folding, and partly, at least in certain places, to excavation along certain fracture-lines; and this view is probably the one which, in the present state of our knowledge, it is safest to follow.

Arldt, it will be noted, is quite clearly of opinion that the present Nile was already in existence towards the end of the Pliocene; and the more recent researches of Sandford and Arkell would seem to support this view. Arldt, however, appears to consider that the Ur-Nil of Blanckenhorn was simply "deflected" to the present course of the Nile, a view which would be of very great interest with regard to the history of the Nile, but which unfortunately does not seem to rest on any reliable foundation. The existence of the so-called Ur-Nil during the greater part of the Tertiary is not denied; but that it was a stage in the evolution of the present Nile, and not merely a "fossil" river, is by no means certain.

Arldt further traces out other stages in the evolution of the Nile in the following manner:

The Ur-Nil did not derive its water supply from the Abyssinian Highlands, but mainly from the Nubian Plateau. Its headwaters were the lower Atbara and the present Nile from Berber to Abu Hamed. At Abu Hamed it received from the west a tributary which flowed from the south-west, whose lower course was very much the same as the stretch of the Nile between Old Dongola and Abu Hamed (except that it then ran in the opposite direction). At Abu Hamed the proto-Nile ran more or less directly to the north, through the present wadis of Gabgaba and 'Allaqi; then, crossing the present Nile between Kurusku and Aswan, it flowed through the Libyan desert, where relics of its existence may still be found in the water-supply of the oases of Kurkur, Dakhla, Kharga, Farafra and Bahariya.

In its upper course the same river received yet another tributary,

at Berber, which came from near Khartoum; and still another at Kurusku, whose lower course was indicated by the present Nile between Kurusku and Old Dongola; while its upper course, which is now traceable in the Wadi Malik back to the Highlands of Darfur, lay further to the south-west.

The Blue and the White Niles should not, according to Arldt, be considered as part of the proto-Nile system. The White Nile did not then exist at all. The Bahr el Ghazal Basin formed a giant inland lake, extending from Dar Fertit to Abyssinia, whose existence is unmistakably indicated by the flatness of the country, and which, during the Pliocene, gradually dried up and gave birth to a river system extending from East to West, its principal sections being the Rudolf system, the Bahr el Zaraf, the Bahr el Ghazal, the Bahr el 'Arab, the Bahr el Salamat and the Chad Basin.

As regards the Blue Nile and the Upper Atbara, they belonged to a river system which drained northwards through the region now occupied by the Red Sea, and discharged into the Mediterranean somewhere in the area corresponding to the present peninsula of Sinai. Towards the close of the Pliocene, the Nile, as already stated, was deflected more or less to its present valley; and the Upper Atbara, the Blue Nile, and the White Nile up to Kodok were captured and added to the Nile system, through headward erosion.

Arldt considers that this must have happened before the formation of the Red Sea; because, he argued, had this already taken place, the streams flowing into it would have had a much stronger eroding and capturing power than the long and gentle streams of the Nile system. He thus attributes to the formation of the Red Sea a very recent date. But he fails to take into consideration the possibility that no important streams need necessarily have flowed into the Red Sea then any more than they do now, the course he gives to the Blue Nile being utterly hypothetical. As a matter of fact, the orthodox view as to the date of the Red Sea is that advocated by Marinelli and Dainelli and supported by Gregory, namely, that the Red Sea trough was in existence before the Oligocene, and was flooded by the waters of the Ocean in the Upper Pliocene[1].

Arldt attributes a very recent date, the "Diluvium," to the addition of the waters of the Bahr el Ghazal, the Bahr el Jebel, and the Semliki system to the Nile, apparently also through backward erosion. More recent still, according to him, is the addition of the waters of Lake Victoria through the formation of the Ripon gap, the Karuma Gorges

[1] Cp. Gregory, *Rift-Valleys and Geology of East Africa*, p. 347.

and the Murchison Falls. With regard to the great bend between Abu Hamed and Aswan, Arldt considers it as being of very recent age, which it undoubtedly is. The Nile has here reversed its previous course, and has abandoned its former channel running between Abu Hamed and Kurusku. The cause of this change is perhaps the most difficult problem in connection with the evolution of the Nile. Arldt seems to be inclined to consider it as due to earth movement, causing an elevation of Eastern Egypt, and making it easier for the present course to be followed. There is, indeed, other evidence in support of a general elevation of Eastern Egypt in quite recent times. Such evidence is, for instance, the gradual disappearance of the mouths of the River Nile in the eastern Delta, as well as the reduced size of the Damietta branch as compared with the Rosetta branch. This, of course, refers to Lower Egypt, but may also be considered to have been the case as far south as Nubia. The change of channel at Aswan may also be due to the same cause. The region through which the Nile makes this great double bend is unfortunately one of the least known parts of the whole of the Nile Basin; and the difficulty of explaining this unique feature of the river is largely due to the state of our ignorance of the topography and geology of the desert lands to the east and west of the Nile Valley between Khartoum and Aswan.

To conclude this brief account of Arldt's views, it seems that a great deal of the picture he has drawn is quite acceptable, with the notable exception of the account he gives of the Blue Nile and the Upper Atbara, and his contention that they belonged to a system which flowed into the Mediterranean, over what is now the Red Sea. If we accept the orthodox view that the Red Sea trough was already in existence before the Oligocene, such a river system could not have obtained. There seems to be no reason why the Blue Nile and the entire Atbara should not have fed the Ur-Nil just as they now feed the present Nile. Blanckenhorn seems convinced that the proto-Nile was a giant stream: "Riesenstrom." It would appear that for such a great river a much more abundant water-supply would be necessary than that which could be drawn, even under most favourable conditions, from the Nubian plateau and the Darfur Highlands. Further, it seems possible to correlate the gradual uplift of Abyssinia towards the end of the Mesozoic, and the beginning of the Eocene with the coming into existence of the Ur-Nil in the period immediately following it; and it is more natural to correlate the two occurrences than to give to the Blue Nile and the Atbara a separate course, which they are not likely to have followed.

II

We may now pass on to deal very briefly with another set of hypotheses, relative to the history of the Nile, which have been advanced to explain certain biological problems concerning the distribution of fresh-water fauna in Africa. Dr G. A. Boulenger found that the fishes of the Nile showed so many specific types in common with those of the Niger and Senegal, the Congo and the Zambezi as well as with those of the Lake Chad system, that he felt justified in postulating a recent connection between these various systems, now more or less entirely separated from one another. Lake Rudolf, too, has four-fifths of its species in common with the Nile system. He considered that many of the generic types characteristic of all these systems must have radiated from a common centre of origin, which, according to him, consisted of "those great central lakes, which are believed to have existed in Middle Tertiary times." He further thought that Lake Chad represented the dwindling remains of a larger basin which communicated, until quite recent times, with both the eastern and western river systems[1].

Some writers have further attempted to draw an outline of the proto-Nile in such a manner as to harmonize with Dr Boulenger's contentions. Some went perhaps a little further than the case required. Theodor Arldt's attempt has already been described. It is far easier to accept than that of such writers as Holmes and Stigand[2]. These writers were anxious not only about the question of how to account for the similarity of the fauna, in various river systems of Africa, but also with the question of finding an alternative outlet to the waters of the Great Lakes of Africa, at a time when the Bahr el Jebel gorges did not exist. They, therefore, suggested that the proto-Nile flowed somewhere to the west of Lake Albert and pursued a north-westerly route, running between Darfur and Wadai, and ultimately joining the Bahr el Ghazal (the Chad river of that name, and *not* the Nile tributary) which was then according to them an effluent and not an affluent of Lake Chad. Connection with Lake Chad thus secured, the river now ran northwards presumably in the bed of what is usually known as the "Wadi el Fadi," or empty valley, and after passing through the Tibesti country the stream ran north-eastwards to the Mediterranean.

Major Stigand found that his suggestion would explain the presence

[1] "Distribution of African Fresh Water Fishes," *Nature*, 1905, pp. 413 *sqq*.

[2] Cp. *G.J.* XLVIII, pp. 145–59; also C. H. Stigand, *Equatoria* (1923), Chapter II.

of the Wadi el Fadi, "that large and empty river bed, which has puzzled travellers and geographers." But however desirable it may be to explain an empty wadi, there are in the deserts of Egypt and of Africa far too many empty wadis and not nearly enough proto-Niles to explain their existence[1]. It does not seem to have occurred to the writers that the course of their river would be seriously blocked up by the Tibesti range, which would make its further extension to the north quite impossible. The matter has also received careful investigation by the French expedition 1912–17 under Col. Tilho, who was particularly concerned with the question of exploring all possibilities of any previous connection between Lake Chad and the Nile[2]. He found out that the mountain barrier encircled Lake Chad on the north-east; and after examining the region with the "utmost care" he came to the conclusion that "the basin of Lake Chad constituted in the centre of Africa a closed basin, which has never been connected with the Basin of the Nile." It would indeed in any case appear highly unlikely that the waters of the central Lakes should have been adequate at any time to feed a great river and enable it to wind its way through the Sahara until it reached the Mediterranean. It should always be borne in mind that the present Nile is only able to reach that destination by the immense contributions of the tributaries flowing from the Abyssinian Plateau.

It would seem that the great east–west river system suggested by Arldt is quite sufficient to explain the similarity between the fauna of the Nile and that of the other systems. But even such a suggestion is not absolutely essential. That similarity seems to be susceptible of an easy explanation if we bear in mind the fact that the sources of the Nile and the Congo, of the Ubangi and Shari, of the Sobat and the Omo are in places so very close together, that in time of flood there might be a temporary connection between the one system and the other[3]. The possibility of river capture, even on a very small scale, at the headwaters of some of these systems, and the possibility of very slight elevation or of subsidence occurring, are together quite sufficient to explain the removal of a small tributary from the one system into that of the other, and the question of the similarity of the fauna of the various systems would thus receive a simple solution.

Less susceptible of an easy solution is the question of the similarity

[1] Dr John Ball has in a recent article, "Problems of the Libyan Desert," shown beyond all reasonable doubt that there was no empty wadi in that desert, which could have been at any time the bed of the Nile, see *G.J.* 1927.

[2] "Exploration of Tibesti," etc., *G.J.* 1920.

[3] Cp. Boulenger, *op. cit.*

of the fauna of the Jordan and the Dead Sea system to that of the Upper Nile. The presence of equatorial fresh-water fish in the Jordan, in an area far removed at present from all contact with equatorial regions, was obviously a problem that needed some explanation. Crocodiles are found in the Jordan and the Zerqa River; and Prof. Gregory has enumerated several species which he found to be common to both the Jordan and the Upper Nile, which, however, do not exist in the Lower Nile.

It is, therefore, very helpful to assume a direct fresh-water connection between the Upper Nile and the Jordan; and this connection was not by way of the Lower Nile, whose fauna is distinct from that of the Jordan. The drainage of the Great Lakes, it is assumed, did not become connected with the Lower Nile until a later geological phase, when the general fauna of the Nile had undergone a considerable change, while certain species common both to the Jordan and the Upper Nile survived.

Prof. Gregory maintained that a great river flowed from Palestine southwards, through the Gulf of ʻAqaba, down the depression which is now the Red Sea and poured its waters into the Indian Ocean, not far from the site of the present Aden. This stream, which he called the Erythrean River, before discharging into the Indian Ocean, received on its right bank a mighty tributary coming from Central Africa, and bringing with it the drainage of the Great Lakes, as well as the waters of Lake Rudolf. The drainage of the Equatorial Lakes flowed north-eastwards into Lake Rudolf, the connecting link being the Turkwell. Then at the northern end of Lake Rudolf, a river flowed to the north-east, along the course of the Omo and the Hawash, until it joined the Erythrean River. Subsequent earth-movements and the growth of volcanic mountains like Elgon almost coinciding with the breach of the Latuka Highlands severed the connection between Lake Rudolf and the Great Lakes, and at the same time provided an alternative outlet for the drainage of the latter.

This theory sounded quite possible though obviously far-fetched, until it received a severe blow when it was found out that the Turkwell was itself in a very youthful and immature condition, and thus could not have acted as a connecting link in the manner indicated, at such an early geological time when the Red Sea itself had not yet come into existence. It seems still very much safer to assume that in some manner or other the Jordan was connected rather with the Middle and Lower Nile than with any Erythrean stream.

III

The evolution of the Nile receives a new interest, rather different from that underlying the theories previously mentioned, when we come to look upon it as a means of explaining the peculiarities and anomalies, characteristic of the river as it now exists. The Nile is not a normal or a "typical" river, in the sense that the Rhône, or the Tigris, or even the Amazon is. We have been accustomed to expect that the course of a normal river should divide into three parts, each part merging gradually into the other; the upper part being a torrent, whose channel is narrow, beset with rapids and waterfalls; the middle being much smoother, with few, if any, rapids or cataracts; while the lower part is normally a flood plain—largely made up of the deposits brought down by the river itself—through which it winds its way to the sea. These three sections are fairly clearly defined in the case of a great number of rivers. With the Nile, however, there is in places almost a reversal of these conditions. One or two examples will clearly illustrate this point. The Nile between Lake Albert and Nimule is a wide stream, with an exceedingly slow current, and a very gentle gradient of about 1 : 35,000. Below Nimule and up to Gondokoro the river is beset with five or six series of rapids; and the channel is swift and the slope is about 1 : 900. Prof. Suess was, long ago, struck by the exceedingly youthful nature of the river between Nimule and Gondokoro, which must obviously be of a much more recent age than other parts of the river which show signs of more complete maturity. Such sections of the river as the Ripon Falls, the Karuma Rapids, the Murchison Falls, and the Beni Rapids of the Semliki, are of a much more juvenile character, and presumably of a more recent age than the mature stretches, with which they are connected. Again, we have to face a difficult problem in comparing the White Nile above Khartoum with the main Nile between Khartoum and Aswan. Above Khartoum the river is wide, very sluggish and has a very gentle gradient, in places scarcely any at all. Its slope is something like 1 : 90,000, whereas below Khartoum the river is beset with several cataracts, some of them of a very formidable character, when the slope is often about 1 : 2000.

The same is true as regards navigability. The Nile is navigable between Aswan and the sea, but is unnavigable throughout most of the region between Aswan and Khartoum; while it is again quite navigable and without any serious hindrance or obstacle, except Sudd grass, from Khartoum to Gondokoro. Then it is utterly

unnavigable over the Bahr el Jebel gorges; and navigable above Nimule to Lake Albert. The other obstacles to navigation are the Murchison Falls, the Karuma Rapids and the Victoria Nile some distance below Jinja, as well as the middle section of the Semliki.

Ignoring for the time being the Blue Nile, whose characteristics are, on the whole, perfectly normal, we find that with regard to the Nile we have a river, which has not developed as one whole whose different parts stand in normal relation to one another, but whose different sections have developed more or less independently, and have been joined together by subsequent developments, the immature parts of the river joining at a later date those sections which have previously reached a state of greater maturity.

It is necessary to consider, first and separately, the question of the Nile in Nubia. The Nile which runs almost persistently from south to north suddenly reverses its course at Abu Hamed, and for about 160 miles runs in a south-westerly direction. Arldt's explanation has already been given. Prof. Gregory finds that this stretch of the river is in line with an also unexplained breach of the western rim of the Red Sea Basin between Jebel Erba and Adar Qaqa mountains[1]. Prof. Gregory further finds that the discovery by Dr Chalmers Mitchell of a field of volcanic hills (described as craters) in the Bayuda desert between Berber and Korti might give a good clue as to the cause which has forced the river to seek another channel to the east, when its older channel must have been blocked up by these volcanic deposits.

All authorities naturally agree that the Nile from below Khartoum to Aswan is a very immature stream and its channel must be of very recent formation. The cataracts in this region are being so quickly worn away that they could not have been subject to the present erosion for a very large period of time. Unfortunately the country to the east and west of the Nile in this section is so very imperfectly known that it is useless to hazard any suggestion as to which of the views advanced is likely to prove correct.

With regard to the Upper Nile, our knowledge of the topography and geology of the country is greater than in the case of Nubia, and a more correct picture of the stages of the evolution of the Nile in this region may be formed. The regions of rapids and waterfalls represent the more recent sections of the river, which have linked together basins which were previously independent. Each of these basins consisted of a lake, which was the collecting centre for a drainage

[1] *Rift Valleys and Geology of East Africa*, p. 351; also in *Nature*, CIV, p. 667.

system of its own. Such lakes were much larger before they became part of the Nile system than they are at present. They may conveniently be divided into two classes: those that lie in deep rift-valleys, and those lying in depressions due to subsidence. To the first class belonged: (*a*) Lake Edward, which had its own drainage, including the Upper Semliki, and also at one time the drainage of Lake Kivu; (*b*) and Lake Albert into which flowed at one time the waters of the Upper Nile above Nimule.

To the second class belonged: (*a*) Lake Victoria, which was a closed basin before the breach of the Ripon gorge; (*b*) Lake Kioga, into which the Victoria Nile flowed; (*c*) lastly, the great depression lake covering the area which now constitutes the lower basin of the Bahr el Ghazal, the Bahr el Jebel and the Sobat, a region whose swampy character and monotonous flatness are very striking. Before the White Nile, through backward erosion, was able to tap the stored waters of this great lake, it acted as the depository for all the waters of the Upper Nile.

These different basins must have maintained their independent existence for a considerable time, to render possible the development to that state of maturity, which is characteristic of many sections of the Upper Nile. The union of these systems together to form the so-called Upper Nile Basin was effected through the agency of tectonic movements and fractures, aided by the erosive power of the streams themselves. Though it is difficult to give the exact order in which these various events took place, this may partly be attempted.

One of the principal grounds for considering Lake Victoria and its tributaries to have been formerly an independent drainage system is the fact that at one time its surface stood at a very much higher level than it does at present. According to Felix Oswald, there must have been during the Miocene a considerable transgression of Lake Victoria, and this remained the case down to the Pliocene. He found on the east and north-east coast of the lake deposits which denote that its level stood then at a height of 300 ft. above the present one[1].

The late Sir William Garstin also found the same kind of deposits at about the same altitude on the west coast, on the cliffs to the north of the Kagera mouth[2]. Again Scott-Elliot found traces of another shore-line which stood at about 100 ft. above the present level[3]. It

[1] *Journal of East Africa Nat. Hist. Soc.* Nov. 1918; also *Q.J.G.S.* 1914, pp. 128 and 188.

[2] *The Basin of the Upper Nile*, Cairo, 1904, pp. 32–9.

[3] *A Naturalist in Mid-Africa*, p. 39.

would seem, therefore, that the reduction in the level of the lake was in two stages. The first was provided by the breach at the Ripon Falls, which probably occurred in the Pliocene, and which enabled a large part of the waters of the lake to pass into Lake Kioga. The second stage, which followed after an appreciable interval, was the result of the formation of the Karuma and Murchison gorges, which are of a very recent formation, and which enabled the waters of the Victoria and the Kioga to pass into Lake Albert.

Probably before this last stage was reached, the waters of Lake Edward had already found their way into Lake Albert. Lake Edward also exhibits the same evidence of a formerly greater volume and higher level, which was reduced in two different stages. The former shores are indicated by lacustrine deposits about 300 ft. and 30 ft. higher than the present level of the lake; and the double reduction in the level of the lake was due on the one hand to a connection with Lake Albert being provided, and on the other to the separation from Lake Kivu by the formation of the volcanic masses of the Mfumbiro system[1]. It is difficult to say which of the two factors accounted for the greater loss in the volume of the lake; but probably the discharge into Lake Albert accounted for the greater reduction of volume.

The view that the waters of the Albert and Edward were once separate is supported by an examination of the River Semliki. At the point where it flows from Lake Edward it is about 180 yds. wide, and at its junction with Lake Albert it is wider still. But in its middle reaches the channel narrows down to a width of about 40 yds., and its banks are 40–50 ft. high. The middle course of the Semliki is a torrent-track with numerous rapids; while both its upper and lower reaches are slow and well graded. Clearly both at its mouth and at its source the river is fully mature, while in its middle course it is exceedingly juvenile. One inference is irresistible, namely, that the upper and lower Semliki were once two separate rivers; the former flowing south into Lake Edward, and the latter flowing northward into Lake Albert. The middle course, which is much the more recent part of the river, is the result of erosive action by both streams in the intervening mountainous tract, perhaps along lines of fracture of a recent date. In this manner a connection between the upper and lower Semliki was effected, and the waters of Lake Edward passed into Lake Albert[2].

[1] E. J. Moore, *To the Mountains of the Moon*, 1901, pp. 222 *sqq*.

[2] Cp. the following statement in Garstin, *op. cit.* p. 9: "What caused the lowering of the Lake (*i.e.* L. Edward) is difficult to understand. That the valley to the north of the Lake must at one time have been blocked across, and the water held back appears certain."

It is notable that of the Great Equatorial Lakes, Lake Albert does not seem to show evidence of a formerly higher level. In this respect it constitutes perhaps the exception which proves the rule. It has not diminished considerably in volume because, although its waters ultimately had an outlet into the Bahr el Jebel, after the breach of the Nimule-Gondokoro gorges, it received ample compensation by the addition to its waters of those of the Victoria and the Edward systems.

Lake Albert, however, was probably connected to the Bahr el Jebel soon after its junction with the other lakes was effected. There does not seem to be any reason for believing that the Karuma-Murchison gorges are of very different age to the very young and fresh gorges between Nimule and Gondokoro. Here the Nile undoubtedly runs in a rift-valley and along lines of recent fracture. The River Asua, whose course is in almost direct line with that of the Bahr el Jebel, is probably due to the same tectonic movements. The whole of the waters of the Upper Nile Basin thus found an outlet into the great Bahr el Ghazal depression; which must have been maintained as an extensive lake, without an outlet for a considerable time. The White Nile has perhaps come into existence partly as a tributary of the Blue Nile, and partly as a tributary flowing south into this great depression. The former was probably the stronger of the two and its development enabled it to tap the stored waters of this great depression.

It is essential to bear in mind that it was the development of the Blue Nile that has enabled the waters of the Lake Plateau to be at all joined into the Nile system. Left to itself the Upper Nile system would have remained one of internal drainage, and would not have found its way to the sea. The most important stage in the creation of the Nile was thus the elevation of the Abyssinian Plateau, which occurred at different stages towards the close of the Mesozoic and continued perhaps to the end of the Tertiary. The vigorous Abyssinian streams thus came into existence, which were able to excavate the channels of the river Nile, and to develop tributaries which were able to tap and to capture the waters of the equatorial system. Thus, although we all consider the main river Nile as extending to the Mediterranean from beyond the Equatorial Lakes, and that its sources lay in that region, it is well to bear in mind that these so-called sources have been but a subsequent addition to the river, long after it had come into existence.

DR W. F. HUME stated that Mr Craig and he had suggested that the western wind system of Southern Europe, which now only just touches Egypt, was possibly driven southwards. The winds striking the Red Sea Hills would have deposited their rainfall, and torrents rushing down to a pre-existing

valley would have given rise to an Egyptian Nile. On the other hand, winds from the Atlantic striking the Abyssinian Hills would have produced streams which, gradually working their way northwards, would have brought down the clayey deposits which form the Nile mud. This mud only occupies the upper 10 m. of the Nile deposits, overlying an unknown thickness of sands and gravel. The question of the Nile in the Libyan desert is one over which much thought is still required. The attention of geographers was directed to the deep channels immediately in front of the Aswan, Semna, and Dal cataracts, where depths of over 40 m. had been obtained, a feature which was possibly to be found also in other cases.

PROF. EMM. DE MARTONNE, le Président, en clôturant la session de la Section de Géographie physique, remercie les Vice-Présidents et particulièrement le Secrétaire, qui l'ont aidé à accomplir sa tâche. Il remercie également les orateurs qui ont bien voulu se plier à la discipline du Congrès, les assistants dont l'assiduité a donné l'impression d'un intérêt soutenu, et dont les observations ont souvent aidé à éclaircir les problèmes soulevés.

La Section de Géographie physique est celle qui a le plus travaillé, si l'on considère le nombre des communications (plus de 30) aussi bien que celui des observations présentées. Les discussions y ont été souvent vives. Nous avons entendu 8 communications sur la question des terrasses, mises à l'ordre du jour par le Comité Exécutif, et adopté à ce sujet un vœu. Nous avons entendu aussi une série de communications sur les variations du climat et émis un vœu en faveur de la nomination d'une commission chargée de recueillir des documents utiles à l'étude de cet important problème. Il est permis de remarquer que nous n'avons eu aucune communication sur la morphologie de l'Angleterre. Par contre nous avons eu la bonne fortune d'entendre de très intéressants exposés sur le Japon, l'Égypte, le Congo, sur les dunes en général.

Le caractère des délibérations de la Section de Géographie physique pourrait en somme être résumé ainsi : sérieuse étude de deux questions générales mises à l'ordre du jour du Congrès, aboutissant à des résolutions dont on peut espérer des conséquences utiles—curiosité éveillée surtout par les pays lointains, où les problèmes morphologiques se présentent dans des conditions différentes de celles prévalant dans l'Europe occidentale.

SECTION C. 19–20 JULY

19 JULY

ORTHOPTERA OF MOUNTAINS IN THE PALAE-ARCTIC REGION

B. P. UVAROV

[*Read by* Dr R. F. Scharff]

See *Mémoires de la Société de Biogéographie: II. Contribution à l'Étude du Peuplement des hautes Montagnes*, Paris, 1928, pp. 135–41 (in English). Abstract (in Italian) in *L' Universo*, Firenze, Nov. 1928, IX, 11, p. 1110.

Other works: *The Geographical Distribution of Orthopterous Insects in the Caucasus and in Western Asia: Proc. Zool. Soc. London*, 1921, pp. 447–72.

Mission Guy Babault dans les Provinces centrales de l'Inde et dans la Région occidentale de l'Himalaya. Résultats scientifiques. Insectes, Orthoptères, Acrididae, Paris, 1925, 40 pp.

Podisma Kingdoni, sp.n.: A Contribution to the Zoogeography of the Himalayas: Ann. Mag. Nat. Hist., London, ser. 9, XX, pp. 481–4.

Abstract

ORTHOPTERA are essentially thermophile animals and, therefore, the alpine fauna of Orthoptera is poor in species, though rich in individuals. Most of the alpine species belong to Acrididae (short-horned grasshoppers), but there are also a few alpine Tettigoniidae (long-horned grasshoppers). Practically all alpine Orthoptera are wingless, with reduced ocelli and reduced tympanal organs; this feature may be in some way connected with the habitat.

Alps. The fauna of the Alps is poor in species and consists mainly of species belonging to the fauna which originated in the ancient Angara continent and spread into Europe and North America contemporaneously with, or immediately after, the Glacial period. Some species show definite Mediterranean affinities and they present evidence of the secondary penetration of Mediterranean elements into the alpine zone.

Pyrenees. Angara elements less numerous, but penetration of the Mediterranean elements more clear, than in the Alps.

Mountains of Spain. Very poor representation of Angara fauna, but Mediterranean elements developed in great variety.

Apennines. General character of the fauna like that of the Pyrenees, but the fauna is still very little known.

Mountains of North Africa. No trace of true Angara elements, and the true alpine forms are, so far as known, purely Mediterranean in origin.

Balkans. Fauna very similar to that of the Alps; Mediterranean elements scarcely represented.

Caucasus. The Angara elements fairly prominent, though some of them lacking while others developed into local species. Mediterranean species also produced here specialized forms.

Mountains of Asia. The influence of the Angara fauna is strong in the northern mountain ranges of Asia, less strong, but pronounced, in Tibet and in the Himalayas; but the great mountain ranges of Turkistan are strikingly devoid of Angara elements in their alpine fauna, which is composed of representatives of groups with clear subtropical affinities. This latter fact may only be explained by the suggestion that a subtropical fauna of Indian type populated Central Asia before the rise of the Himalayas and representatives of this fauna had been lifted to high altitudes when the Himalayas arose; most of it died out, but some species survived and developed into special alpine forms. The absence of the Angara elements in the Turkistan mountains may be accounted for by assuming that the rise of the Turkistan ranges occurred after the period of the maximum expansion of the Angara fauna, which was unable to populate subtropical regions of Central Asia.

Thus, a fundamental difference exists in the composition and origin of the alpine faunas of European mountains, the Caucasus and the Altai, on the one hand, and the mountains of Central Asia and the Himalayas, on the other.

PROF. J. STANLEY GARDINER remarked that these meetings were held for public criticism, but that it was unpleasant to criticize an author in his absence. He referred to the work on the Alpine and other Faunas of Prof. Zschokke, Dr Handschin, the Geneva and Zürich schools and many Swiss naturalists. Much of this dealt with other pre-Permian groups of animals and he envisaged the problem as that of the distribution not of two out of seven or eight families of Orthoptera, but rather as of all insects, or perhaps of all land animals, of similar evolutionary age. While many forms of Short- or Long-Horned Grasshoppers might love warmth, he thought that the requisite evolutionary stimulus which formed the families and larger subdivisions was likely to have been cold. He did not see in the paper as read evidence that the peculiar high level species were "adapted" from those which occupied hot lands. He felt that the first step is to classify the biological or anatomical characters of animals according to their supposed antiquity, and then to consider them in relation to proved land and ice movements. He trusted that the present geographical consideration would be extended to all Orthoptera, in which group valuable geographical results seemed more possible than in any other insect group. He could not see that there is any fundamental biological difference in insects from other animals that would make their distribution different.

VEGETAL AND ANIMAL POPULATION OF HIGH MOUNTAINS

PROF. G. NEGRI

See *Popolamento Vegetale ed Animale delle Alte Montagne: Comitato Geografico Nazionale Italiano*, Firenze, 1928, 17 pp. (in Italian). [Presented to Congress.]

Other works: *Le Colonie Vegetali Xerotermiche della Val di Susa ecc.: Memorie della R. Acc. dei Lincei*, Roma, 1921, ser. 5, XIII, 18, *passim*.

Richerche sulla Vegetazione del Bacino Glaciale del Lys (Monte Rosa): Boll. del Comitato Glaciologico Italiano, Roma, 1925, 6, pp. 69–85.

Abstract

The Italian Delegation argues that (notwithstanding the valuable contributions recently added to our knowledge of vegetal and animal populations of high mountains) a further collection of data is required in a series opportunely chosen of mountain groups, and indicates to inquirers these essential tasks:

1. *To specify exactly the extension that should be attributed to the term Mountain population.* We believe that the limiting of researches above the limit of arboreal vegetation deducts from the investigation many documents offered by lower levels, and even by whole mountain groups, especially in the tropical zone. We suggest then to extend the investigations to the entire population of each mountain group, considered in its complete topographic individuality.

2. *To describe the biocenosis of mountain vegetation, classifying them according to their stational conditions.* Besides the synecologic study of each *biocenosi* and its variations according to oscillations of climate, animal migrations, epidemics, etc., even the investigations on the influence of human economy on the plants and the behaviour of biocenosis in contact with the glaciers, with areas invaded by eruptive products (indicating modifications undergone during periods preceding the present) are included in this argument.

3. *To subject vegetal and animal species, forming each biocenosi, to an exact chorological study.* It is believed to be opportune that the actual species areas should be studied with great attention to the real importance of separation phenomena, even to the isolation of relict species in mountain groups as well as in surrounding territories of supposed refuge; and that, on account of their geographical affinity, they become classified in a limited number of geographical components (Reichert 921).

4. *To ascertain the degree of mobility of each species.* Besides the study of dispositions peculiar to each species and regarding the transport of disseminules, the study of effective production of each one in seed also takes part in this argument; of direct or scalar germination power of each of these, of duration of germination power; moreover, the collection of documents on eventual possibility and efficiency of dissemination at a distance.

5. *To assemble (by direct ecological observations, comparative cultivations of the same form at different levels, and cultures of pleiomorphic species) elements for the interpretation of endemisms of various degree.*

DR R. F. SCHARFF agreed with Prof. Negri in his suggestion that the study of the mountain fauna and flora should be limited at first to certain specified mountain ranges. He thought, however, that it was desirable to limit the faunistic researches at any rate to the higher levels so that the enquiry into the origin and distribution would be restricted to a less formidable number of species. Much work required to be done before we could arrive at any definite conclusions, although the botanical researches especially had already yielded many results of far-reaching importance.

[See *Commission No.* 5, p. 46.]

HISTORY OF THE DISTRIBUTION IN THE HIGH MOUNTAINS OF SOUTH-WEST EUROPE OF *VITALIANA PRIMULAEFLORA BERTOL.* THROUGH THE ANALYSIS OF SYSTEMATIC VARIABILITY OF SPECIES

PROF. A. CHIARUGI [*Communicated*]

Abstract

Vitaliana primulaeflora Bertol. appears from systematic analysis to consist of varieties and forms with well delimited geographical distribution.

The commonest variety is *alpina Chiarugi*, in the Pyrenees and Alps, which has segregated into a form *occidentalis Chiarugi* with xerophytic habit in the Pyrenees and in the Western Alps as far as a part of Valais, and a form *orientalis Chiarugi* with mesophytic habit, which in its turn includes a subform *leopontina Chiarugi* in the Lepontine Alps and a subform *tridentina Chiarugi* (in which the mesophytic habit is pronounced) in the Eastern Alps. There are also the varieties *praetutiana* (Bus.) *Chiarugi* and *nevadensis Chiarugi* localized on the mountains of the Abruzzi and the Sierra Nevada, in which the xerophytic character is particularly pronounced.

The disjunction of species areas and the systematic isolation of the monotypic genus made Engler believe that a primitive tertiary generic

type (spread over the Mediterranean basin in the lowest regions and nowadays extinct) generated the alpine variety which has survived by means of parallel variations in different parts. Such a hypothesis receives to-day (from systematic analysis) new support from a different line of research; for in the alpine parts of the Abruzzi and the Sierra Nevada not the one identical form but different varieties unknown to Engler are found. The law (established by Chodat) that "the preglacial alpine forms have their parallel forms in the most southern mountain massifs of the Mediterranean basin" thus receives new support. If the origin of the three varieties is preglacial, the distinction of forms of variety *alpina* has resulted from glacial phenomena.

The genuine western type with xerophytic habit had a wide refuge territory in the Dauphiné and Provence, finding conditions adapted to its exigencies; from there it returned by way of the Graian Alps, avoiding Mont Blanc, as far as Valais. The eastern form remained in a few refuge stations on the southern side of the Alps, assuming (on account of adverse conditions) a mesophytic character. The subform *leopontina* across the Lepontine Alps contributed to the repopulation of Valais, mixing and hybridizing itself with the western form but maintaining itself pure to the north of the Simplon.

The history of *Vitaliana primulaeflora Bertol.* shows that it is by nature a Mediterranean alpine element of tertiary origin, belonging to a phyletic branch of the family that has precociously lost its evolutive power and evidently possessed during its last geological vicissitudes a very feeble power of adaptability.

THE ACTUAL DISTRIBUTION OF TETRAONIDES (AVES) IN ITALY

PROF. E. MOLTONI [*Communicated*]

Abstract

The Tetraonides actually existing in Italy belong to four species: mountain or white partridge *Lagopus mutus helveticus* (Thien.), mountain pheasant *Lyrurus tetrix tetrix* (L.), capercailye or Urogallus *Tetrao urogallus urogallus* (L.), and mountain heathcock *Bonasa bonasia rupestris* (Brehm). They have been and are even to-day in process of diminution so that several species have now disappeared from some alpine groups. It can be deduced from this that, if protective laws promulgated by the national Government are not

observed, the Italian alpine fauna, already impoverished, will go on diminishing rapidly.

The Tetraonides are resident in Italy only in the Alps and are only accidentally found in the Apennines and in the plain. The distribution of species in the Italian zones of the different Alpine groups is as follows: in the Maritime, Cottian, Graian, Pennine and Lepontine Alps, only the mountain or white partridge and the mountain pheasant; in the Rhaetian Alps, all the four species; in the Lombard Forealps, all the four species, but the capercailye is very rare and tends to disappear, and the mountain heathcock is now reduced to a limited number of individuals; in the Dolomites, Carnic and Julian Alps, and Venetian Forealps, all the four species.

20 July

LIFE AT HIGH ALTITUDES

PROF. J. BARCROFT, C.B.E., F.R.S.

Other works: *Physiological Effects at High Altitudes in Peru: Proc. Royal Institution*, 1922, 23, pp. 608–17.

Physiological Effects of High Altitudes in the Peruvian Andes: Phil. Trans. Royal Society, 1923, Series B, 211, pp. 351–480.

Mountain Sickness: Nature, 1924, 114, pp. 90–2.

The Respiratory Function of the Blood: Part I: Lessons from High Altitudes, Cambridge, 1925, 219 pp.

Remarks on *Physiological Difficulties in the Ascent of Mount Everest: Geographical Journal*, Jan. 1925, 65, pp. 17–19.

M. LE PROF. M. SORRE exprime le très grand plaisir qu'il a éprouvé à entendre le Prof. Barcroft. Il désire lui demander à ce sujet ce qu'il pense de la limitation absolue des possibilités de vie en altitude. Lorsqu'on remplace, sur les figures données par le Prof. Barcroft (*Respiratory Function of the Blood*), la tension d'oxygène par l'altitude correspondante, il semble que la courbe de dissociation de l'hémoglobine tombe plus rapidement à partir de 8600 m. et qu'on soit là aux environs d'une altitude critique. M. Sorre désire savoir si son interprétation des courbes du Prof. Barcroft est correcte.

PROF. BARCROFT presumed that the question concerned the life of man, the curves in *Respiratory Function of the Blood* referring to human blood. It seems clear that the limit of human life is somewhere about 30,000 ft. but depends upon the time spent at the particular altitude. For seconds or minutes man can endure oxygen pressure as low as under 60 mm. Hg; this has been done by Prof. Haldane and his collaborators in a chamber. On the other hand there appears to be no evidence of man living permanently at altitudes higher than 20,000 ft. It may be held that up to 18,000 ft. there are persons permanently in equilibrium with their environment.

PROF. J. W. GREGORY referred to the indebtedness, practical and academic, of those concerned with the development of high altitudes to the work of

Prof. Barcroft. He shared the surprise of Sir Francis Younghusband at the physical vigour of the Tibetans at high levels—(in Chinese Tibet the lack of apparent physical deterioration in them might be due to infrequent residence at less extreme heights); the main effect appeared to be the excitability of the Tibetans. He had personally felt that mental fatigue was cumulative but that physical adaptation to high levels was effective. The question of greatest practical importance in this connection was the effect of life at 6000–8000 ft. and especially on the nervous condition of the people.

RAPPORT DE LA SOCIÉTÉ DE BIOGÉOGRAPHIE DE LA FRANCE SUR LE PEUPLEMENT DES HAUTES MONTAGNES

DR. R. F. SCHARFF

See *Mémoires de la Société de Biogéographie: II. Contribution à l'Étude du Peuplement des hautes Montagnes*, Paris, 1928, 260 pp. [Presented to Section C.] Abstract (in Italian) in *L' Universo*, Firenze, Oct. 1928, IX, 10, pp. 1012–9, Nov. 1928, IX, 11, pp. 1107–15. [See Commission No. 5, p. 46.]

A STATISTICAL SURVEY OF FAUNISTIC LITERATURE IN POLAND UP TO 1880

PROF. A. W. JAKUBSKI

See *Bibljografja Fauny Polskiej do Roku* 1880*: Polska Akademja Umiejętności: Prace Monograficzne Komisji Fizjograficznej*, Tom. III, Kraków, 1927, 470 pp., Introduction (in Polish), pp. V–XVII. [Presented to Section C.]

My bibliography of the Polish fauna up to 1880, which, thanks to the Polish Academy of Sciences at Cracow, has recently appeared in print, enables me to discuss the development of Polish faunology from the standpoint of statistics. This I hold to be important for the following reasons. First, faunology constitutes no insignificant part of natural science and consequently in a certain sense admits of conclusions as to the cultural progress of a nation; it also remains in touch with economic life by what is known as applied zoology. Secondly, the history of the development of faunology, like that of all other sciences, renders it possible at any time to form an opinion on the cultural position of a nation from a special point of view; in the case under consideration, that of Poland, it is only by examining the history and development of our science that the harm done to cultural life by the tripartition of the country can be duly estimated.

Table 1. *Dispositio operum secundum linguam*

	Lingua																
	pol.		germ.		ross.		lat.		franc.		angl.	hol.	bohem.	hung.	sued. danic. finn.	ital.	Summa
Pars I																	
Bibliographia	27	(33)	27		26	(25)	15	(12)	7	(5)	4	—	—	1	2	—	109
Periodica ...	148	(171)	141	(121)	38		8	(6)	8	(7)	—	—	1	—	2	—	346
Biographia ...	89	(98)	62	(59)	54	(53)	7	(6)	20	(16)	4	—	—	—	—	2	238
Historia ...	77	(87)	111		72	(68)	13	(10)	32	(29)	1	—	—	2	2	—	310
Summa ...	341	(389)	341	(318)	190	(184)	43	(34)	67	(57)	9	—	1	3	6	2	1003
Pars II																	
Physiographia	292	(344)	463	(445)	210	(199)	35	(22)	69	(59)	31	7	3	5	3	4	1122
Fauna Contin.	56	(89)	178	(167)	78	(75)	29	(19)	20	(11)	1	—	—	8	—	—	370
Mare Balticum	3	(6)	435		22		37	(34)	21		20	—	—	—	210	—	748
Compendia ...	136	(152)	12		2		16	(0)	—		1	—	—	—	—	—	167
Oecologia ...	173	(191)	84	(74)	14		—		11	(3)	—	—	—	—	1	—	283
Phaenologia...	36	(47)	119	(111)	18	(17)	—		2	(0)	—	—	—	6	—	—	181
Varia ...	85	(93)	26	(24)	25	(22)	6	(4)	5	(4)	—	—	—	—	—	—	147
Summa ...	781	(922)	1317	(1268)	369	(351)	123	(79)	128	(98)	53	7	3	19	214	4	3018
Pars III																	
Mammalia ...	196	(219)	234	(224)	14		23	(15)	29	(24)	8	1	—	1	5	—	511
Aves... ...	128	(159)	330	(308)	10	(9)	16	(13)	8	(4)	1 (0)	—	—	6	—	—	499
Rept.-Amph.	19	(27)	43	(42)	4		10	(4)	7	(6)	—	—	—	5	—	—	88
Pisces ...	53	(64)	73	(66)	8	(7)	16	(13)	5		—	—	—	2	—	—	157
Mollusca ...	16	(34)	113	(104)	3	(1)	8	(4)	13	(10)	—	—	1	—	—	1	155
Insecta gener.	13	(24)	69	(67)	10		17	(11)	14	(11)	—	—	—	2	—	—	125
Coleoptera ...	42	(77)	348	(335)	21	(20)	12	(7)	29	(13)	1	—	—	2	—	—	455
Lepidoptera	26	(34)	206	(200)	6		11		4		3	—	—	2	—	—	258
Hymenoptera	12	(22)	83	(81)	3		10	(2)	6	(0)	—	—	—	—	—	—	114
Diptera ...	20	(37)	119	(108)	15	(13)	10	(2)	7	(5)	—	—	—	—	—	—	171

Table 1 (*continued*)

Orthoptera ...	35 (38)	42 (41)	15 (13)	6	4	—	—	—	1	—	—	103
Neuroptera ...	6	10	1	—	—	1	—	—	—	—	—	18
Hemiptera ...	17 (25)	36 (35)	5	25 (24)	12 (8)	4 (2)	—	—	5	1	2	107
Thysanura ...	(1)	1	—	—	1 (0)	—	—	—	—	—	—	2
Arachnoidea	19 (21)	27	5	1 (0)	5 (4)	—	—	—	5	—	—	62
Myriopoda ...	(3)	6	2	1 (0)	2 (0)	—	—	—	3	—	—	14
Crustacea ...	5 (12)	16 (13)	4	1 (0)	5 (2)	—	—	—	—	—	—	31
Vermes ...	37 (43)	40 (37)	2	3 (2)	2 (0)	—	—	—	1	—	—	85
Coelenterata	5 (9)	3 (0)	2 (1)	—	—	—	—	—	—	—	—	10
Protozoa ...	13 (18)	12 (10)	2 (1)	—	2 (0)	1	—	—	—	—	—	30
Summa ...	662 (873)	1811 (1715)	132 (121)	170 (124)	155 (100)	19 (16)	1	1	35	6	3	2995
Pars IV												
Palaeozoologia	261 (536)	1209 (982)	36 (28)	38 (30)	95 (64)	26 (25)	1	1	3	1	3	1674
Pars V												
Scripta gener.	91 (95)	31 (30)	70 (68)	—	2 (1)	—	—	—	—	—	—	194
Tutela naturae	149 (154)	30 (25)	9	—	—	—	—	—	1	—	—	189
Noxia ...	373 (397)	248 (242)	219 (205)	1	10 (6)	4	—	—	1	—	—	856
Parasita ...	86 (97)	28 (25)	10 (8)	6 (1)	3 (2)	—	—	—	1	—	—	134
Apicultura ...	553 (586)	511 (494)	31 (25)	—	16 (11)	5	—	10 (6)	1 (0)	5	7	1139
Sericicultura	153 (168)	176 (164)	14 (12)	—	2	—	—	1	—	—	2 (1)	348
Venatio ...	274 (275)	31 (30)	11	—	1	—	—	—	1	—	—	318
Piscicultura ...	152 (163)	157 (146)	6	1	5	2	2	1	—	—	—	326
Varia ...	68 (73)	17 (12)	1	4	3	—	—	—	—	—	—	93
Summa ...	1899 (2008)	1229 (1168)	371 (345)	12 (7)	42 (31)	11	2	12 (8)	5 (4)	5	9 (8)	3597
Summa general	3944 (4728)	5907 (5451)	1098 (1029)	386 (274)	487 (350)	118 (114)	11	18 (14)	65 (64)	232	21 (20)	12287
%	32·1 (38·6)	48·1 (44·3)	8·9 (8·5)	3·1 (2·2)	3·9 (2·8)	1 (0·9)	0·08	0·1 (0·1)	0·5 (0·5)	1·9	0·2	100 %

It appears from Table 1 that my bibliography enumerates altogether 12,287 works—(later additions raise this number to 12,309). About half these entries are derived from several existing bibliographies, Polish and foreign; the other half is due to original research in various Polish book collections, undertaken between 1917 and 1927.

Arranged in order of subjects, my bibliography comprises five sections (cf. Table 1), whose further subdivisions and numerical importance in each particular field may be gleaned from the table. Here I only wish to point out certain peculiarities.

The figures in brackets in the column "Lingua polonica" indicate the total number of books written by Polish authors, *i.e.* not only in the Polish language, but also in all other languages; hence the figures in brackets are higher in the column for that language and correspondingly lower in the other columns. It will also be seen that, of the five main sections, the last, viz. Pars V: Applied Zoology, shows the richest development, thus proving that, in Poland, agriculture and natural science kept in very close touch. This throws a most peculiar light upon the disdainful remarks met with in many places concerning "Polish husbandry" ("Polnische Wirtschaft"). In the last column of Table 1 we find the intensity of every branch of science expressed in aggregate numbers of publications. The two horizontal lines at the bottom of the table show the share of each language, both in absolute values and in percentages. Extracting only a few data here, I shall point out the disproportionately large number of treatises on mammals, birds, and beetles, and, on the other hand, a certain dearth of publications on invertebrates.

The total number of Polish contributions, expressed in percentages, amounts to 32·1 per cent. and 38·6 per cent. respectively. The German language occupies the first place, which is not to be wondered at, German being the official language of two of the powers sharing in the Partitions of Poland. The table further indicates the varying intensity with which particular branches of science were dominated by the different languages. Thus, *e.g.* the Baltic remained practically closed to Polish exploration, and there is hardly any work on beetles and butterflies and indeed in the whole domain of entomology, while mammalogy, ornithology, and ichthyology are well represented. It is a pity that most of this work should have remained unknown and unexploited outside Poland. This is the more regrettable as the list comprises the names of the best Polish scientists of the age, as Alth, Belke, Bojanus, Benedict and Ladislas Dybowski, Janota, Jarocki, Łomnicki, Nowicki, Pietruski, Pusch, Radoszkowski, Slosarski,

Sznabl, Taczanowski, Waga, Wałecki, Wrześniowski, and Zejszner. From earlier times, too, a number of well-known names may be mentioned, as Jonstonus, Rzączyński, Cygański, Ostroróg, Strzemiński, Stroynowski, and others.

Much interesting light is shed on the history of Polish faunology by considering the periodicals, as well as the contributions themselves. According to Table 1, we had 148 periodicals, which number declines to 122, if almanacs are left out of account. But even almanacs had to serve as scientific organs in Poland between 1820 and 1860, so small was the number of scientific periodicals deserving the name. To such makeshifts was Polish science driven by the lack of appreciation, not to mention support, in official quarters. And it must also be borne in mind that it was only towards the close of the period that the untrammelled exercise of literary activity became possible, and even then in Galicia only.

In spite of all these impediments the line of development of periodical literature exhibits a marked rise. Out of the total number of papers, only 2 were entirely devoted to natural science, 3 being of a popular scientific character, while 3 others advocated the protection of nature; 19 were devoted to science in general, 18 to matters of general or literary interest, 13 to medicine, 33 to agriculture, 8 to forestry, 4 to stock breeding, 5 to horticulture, 8 to popular economy, and, lastly, 2 to the chase. Of these papers 48 were published at Warsaw, 19 at Lwów (Lemberg), 15 at Vilna, 14 at Cracow, 10 at Poznań, 4 at Leszno (Poznania), and finally, 1 each at 9 different places, some of them small. 37 were published in Austrian Poland, 49 in Congress Poland, 16 in the Eastern Provinces, 18 in Prussian Poland. With regard to the period of publication, in the Eastern Provinces production comes to a dead stop as early as 1859, never having been very prominent since the start in 1804. Prussian Poland, again, does not make its appearance before the eighteen thirties, to lead a precarious existence without marked increase till the close of our period, and to receive its quietus immediately afterwards. Congress Poland is the first to awaken to life, without, however, developing to any marked extent till 1840. Only Galicia shows a regular advance, slowly but steadily gathering strength, to end by competing for the foremost place with Congress Poland.

The spell of life of each periodical must be taken into account. The average lifetime of almost every single periodical is surprisingly short, which can only be explained by the unpropitious political condition the nation had to put up with. Table 2 shows that nearly

one-half of the whole number of periodicals did not survive for more than one, two, or three years, no less than 32 of these publications, *i.e.* 26 per cent. of the total number appearing only for one year.

Table 2

Duration in years...	1	2	3	4	5	6	7	8	9	10	up to 15	up to 20	up to 40	over 40
Number of periodicals...	32	14	12	7	4	7	7	4	6	2	10	4	9	2

We shall be more thoroughly informed about the whole faunistic development, if we turn to the contributions themselves. First of all the question arises, in what numerical relation Polish production stood to that of foreigners, both as a whole and in each particular branch of natural science. We shall discuss this proportion both for the whole territory and for its different parts.

Leaving aside the chapters on bibliography and periodical literature, which do not belong here, as well as the whole literature of the Baltic, we gather from statistics the following facts:

1. The portion of the Polish language (including the work of Polish writers in other languages) has been constantly on the increase since 1791, amounting to more than half the total production in the years 1821–40.

2. Before 1830, the share of the Russian language is hardly worth mentioning, and it becomes more prominent only in the last three decades, though never rising to one-half, and in the last decade falling below one-quarter, of the Polish production.

3. The heading "Other languages" (chiefly French and Latin) does not show any increase for the whole period, and consequently its relative importance declines in proportion as the production in Polish, German and Russian rises.

4. The share of the German language is very considerable from the outset, exceeding half the total amount in the years 1771–1800 and again in the decade 1851–60. It must, however, be borne in mind that this large proportion is due to my having chosen, for the purposes of the bibliography, an area extending far beyond the political boundaries of the old, and, of course, also the new Polish State. The area surveyed includes various border districts, such as the Baltic Provinces of the late Russian Empire, and the territory of the Central Carpathians in their whole extent, in addition to all the land bounded by the Baltic and Black Seas, and by the Oder (except its lower course), the Dnieper and the Western Dvina. This expansion of the

area under survey seemed to be demanded by reasons inherent in the subject, as well as by practical considerations. For it is evident that, in matters concerning the geographical distribution of animals and the ecological factors determining it, it is not the anthropo-political boundaries but the intrinsic properties of the subject-matter that have to be taken into account. Hence the proportion of foreign contributions is much larger than if we had merely examined the political area. The German and Hungarian contributions in particular would then have been much less numerous. Notwithstanding this discrepancy, and perhaps even the more strikingly on account of it, Polish science is seen to maintain its ground with honour. It is something that, of the languages of all the Slavonic peoples that did not enjoy national independence before the Great War, none is so well represented as Polish in science and in the exploration of the natural features of the homeland; but this is not all. As a matter of fact, the scientific literature of Poland was, on the ground under survey, for a long time quite a match for that of the powerful neighbouring empires. This superiority is seen, above all, in comparison with the Russian language, which played but a very subordinate part.

Table 3

	1790	1800	1810	1820	1830
Regnum Poloniae	18	7	22	30	129
Prov. austriaca	7	3	2	14	38
,, rossica	2	2	14	18	72
,, prussica	2	—	1	1	3
Extra fines	1	—	2	22	3
Summatim	30	12	41	85	245

	1840	1850	1860	1870	1880	Summa
Regnum Poloniae	113	210	184	174	426	1313
Prov. austriaca	52	77	122	225	996	1536
,, rossica	16	30	20	11	6	191
,, prussica	58	34	97	151	279	627
Extra fines	18	12	11	13	12	93
Summatim	257	363	434	574	1719	3760

In Table 3 we have brought together certain data showing the relations of Polish production in natural science in the four partitional territories of Poland, as well as abroad (emigration literature), in chronological order, *i.e.* by decades. Here we receive an answer to the question what share each of the parts had in the total production. We find that, as a whole, the number of Polish contributions is comparatively low till about 1810, that it steadily rises from that date

onwards, and that a striking efflorescence supervenes in the last decade. The only point where a certain slackening of the pace occurs is in the fourth decade of last century; had the table been made to show single years instead of decades, it would have become manifest how detrimentally, nay disastrously, the scientific progress of the nation was affected by political events, such as the wars and risings against the partitioning powers (1812, 1830–1, 1863) as well as the "Kulturkampf" in Prussian Poland after 1872. As regards each particular part, it will be seen that Congress Poland shows on the whole the second greatest production, in the last decade yielding the priority to Galicia, which gains its dominant position thanks only to the tremendous rise in the closing decade, being much more modestly represented in the earlier periods. The Prussian part shows that its production does not properly begin till the Insurrection of 1830, to grow ever more intense with a noticeable decline about 1850, while the Eastern Provinces show a faint stir towards 1830, at other times sharing but feebly in the work of the nation. Lastly, the Polish emigration literature has also been represented, moving on an equal level throughout the period, without any noteworthy increase, from 1810 down to the end.

Special tables, which cannot be reproduced here, have been drawn up to show what particular branches of science were most keenly studied in each of the parts. Let it suffice to point out that Galicia engaged chiefly in theoretical studies, while Congress Poland, and still more the Prussian part, where farming is known to have been carried on on an intense scale, evinced more interest in applied zoology. Nor can we omit to mention palaeozoology with its economic significance in Congress Poland, and the purely theoretical work done in this field in Galicia, where the Austrian government systematically prevented the results of scientific enquiry being turned to practical account.

One word more on the problem of the protection of nature. It seems significant that in our country the movement for protecting nature, so highly important from a cultural and ideological point of view, had zealous followers as early as the beginning of the eighteen forties, and it is no more than due to our forefathers to state that in this direction Poland has the merit of having performed original pioneer work.

Certain conclusions remain to be drawn from the whole state of affairs, as above set forth in terms of statistics, and therefore with absolute fidelity to the facts.

In the first place, stress must be laid on the circumstance that the production of Polish science may be called rich in quantity, while not being greatly inferior to foreign production in quality, which cannot be directly seen from the tables. Secondly, I wish again to call attention to the regrettable fact that the work of the earlier Polish writers on science has for the most part remained unknown to foreign students, who are thus unable justly to appreciate the significance of Polish science, as well as being debarred from making use of its results. Unfortunately this is still true even to-day of Poland's scientific literature and its relation to that of Western Europe. Hence it is hoped that the present bibliographical work will be the means of saving from oblivion much valuable material of the past, and thus of rendering a lasting service, not merely to Polish, but to international scientific progress.

THE FOSSIL CLIMATES OF CENTRAL AFRICA

A. TINDELL HOPWOOD, M.SC., F.L.S.

[*Communicated*]

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It is well known that climate affects the character and vegetation of a country, and that the character and vegetation, in turn, affect the country's fauna. Up to the present our ignorance of the geology and fossils of that part of Africa which lies between 10° N. and 10° S. of the Equator has made it hardly possible even to speculate on its past climates. Lately, however, a few facts have been available from which the influence of the climate on the Pleistocene mammalian fauna of Central Africa may be tentatively inferred.

The close of the Tertiary in the Northern Hemisphere was a period of gradual decrease in temperature, and of an oncoming of glacial conditions. The advance of the ice to the north caused a cooling of the tropics, and an increase there of rainfall. Although the first (Günz) glaciation was not sufficiently severe to cause rainfall capable of raising the level of the central lakes, yet it affected the desert belt now known as the Sahara. This region was then well watered, and supported a rich and varied fauna. The climate was fairly warm, with well-marked wet and dry seasons.

As the successive stages of the European glaciations developed, the fauna was driven further to the south, and used the Great Rift Valley as an important route. The rainfall also increased, correlatively the

level of the lakes rose, and the rivers carried more water. This meant a wider area of forest, and a lush, rank, vegetation in the open parts of the country. As a consequence the browsing animals with low-crowned teeth were able to maintain themselves in abundance.

When the European glaciation declined, the amount of rainfall, which had fluctuated with the advance and retreat of the ice-front, became finally scanty, and desert conditions were established in the Sahara. Except for the narrow strip bordering the Nile, Central Africa was then isolated, and mammals could no longer freely come and go. As the humidity of the central part of Africa diminished, the temperature increased; but the process was very slow, and thus the primitive mammals which had taken refuge there were able to exist long after they had become extinct elsewhere.

The change in climate brought about a change in the vegetation. The park type of country developed at the expense of the forest, which became restricted to the neighbourhood of the rivers and their tributaries. Those districts which had formerly been covered by soft, juicy vegetation, now supported harsh, wiry, more or less siliceous grasses, and patches of xerophytic scrub. Naturally, the change in conditions was reflected in the fauna: the animals with the low-crowned teeth had their food supply diminished, and were at a disadvantage when competing against animals of the grazing type with high-crowned teeth; their numbers were greatly diminished and a large proportion became extinct. Thus it is that the larger part of the Ungulate fauna of Africa at the present day is composed of light-limbed animals with high-crowned teeth, such as the equines and antelopes.

It was surmised above that the climatic changes were very slow, and there appears to be some reason to believe that they are still continuing. Comparisons between the reports of travellers made during the last hundred years suggest that the Sahara is slowly extending to the south, and that regions such as that round Lake Chad are becoming desiccated, whilst the lakes themselves are not so extensive as formerly.

In conclusion I wish to thank my friends and colleagues who have worked in Central Africa, and who have been so kind as to send me fossil mammals for examination, as well as copies of their papers, and who have also given me information concerning field conditions, in addition to criticizing and checking the conclusions arrived at from a study of the fossils.

SECTION D. 19–24 JULY

19 JULY

THE CONTENT OF PHILOSOPHICAL GEOGRAPHY

RT. HON. SIR HALFORD MACKINDER

IN this Section of the Congress we have to study those aspects of geography which should be of interest to men of affairs—the statesmen, soldiers, administrators, merchants. In opening our proceedings I propose, none the less, to ask your attention for a few minutes to what I will describe as Philosophical Geography. If you will trust me for a short while, I hope to end by demonstrating the close pertinence of that apparently abstract subject to our proper studies. If you will allow me, I will begin with a few words of history.

Forty-one years ago I was appointed as a very young man to teach geography in the University of Oxford, being the second to hold such a position there. The first was the famous Elizabethan, Richard Hakluyt. Why was there that long interval between my predecessor and myself? Geography had played a great part in the Revival of Learning, the Renaissance. The book of Ptolemy, with its scientific basis for maps, was then many times reprinted. But Hakluyt's main interest was, as we all know, in the great adventure of contemporary travel and discovery. After him for a century and a half geography, apart from the art of navigation, was in the same stage of development as was natural history. It was crudely accumulating facts. Except for "the Use of the Globes" it presented little material for an educational discipline. Gradually the outlines of land and water were recorded, and by the time of the French Revolution the map of the world presented the coast-lines of the continents and most of the islands with a first approach to accuracy. These were the centuries of oceanic discovery; and when in the latter part of the eighteenth century the study of scientific geography was resumed, we find that progress was still in the main incidental to advance in the art of navigation. In England, for instance, the astronomer Hadley put forward, in a paper before the Royal Society, the classic theory of the Trade Winds, and Major Rennell a little later investigated the Gulf Stream. In France about the same time contour lines, borrowed from the canal engineers, were utilized to depict the bed of the English Channel. But the indication of land forms still continued to be rudimentary and merely pictorial.

At the end of the eighteenth century, with the formation of the

the pendulum has swung back, and the regional idea is again in the ascendant in England, in no small measure owing to the work of the Geographical Association, a body now of 4000 teachers of geography, which was founded at a meeting held at Oxford in the middle nineties. It was a striking testimony to the newer tendencies when Dr Hogarth, President of the Royal Geographical Society, whose recent death we lament, in so many words assigned the special cultivation of philosophical geography to the Geographical Association.

What is the content of philosophical geography? Geography has been defined as the study of the distribution of phenomena on the earth's surface. What do we mean by the earth's surface? Clearly not a mathematical surface, with length and breadth but without thickness or depth, for the investigation of climatic phenomena, to take only a single example, obviously demands the consideration of a certain depth of atmosphere.

Surely we may find our first geographic unity in the hydrosphere, a term invented to cover the totality of water on the earth whether gathered together in the ocean, or invisible in the air, or condensed in the clouds, or falling as rain or snow, or creeping down in the glaciers, or coursing down in the rivers, or percolating underground, or rising in the sap of plants or circulating in the arteries and veins of animals. There is probably no complete lacuna in the hydrosphere, though there are thin places over and in the deserts. It would be a vast bubble, if we imagine all else dissolved away. Moreover, the hydrosphere is functionally one; for given sufficient time and every drop might successively take the place of every other drop, passing from the ocean back into the ocean. Obviously life, and not least human life, is possible only within the bounds of the hydrosphere. In purely physical geography nine-tenths of the processes investigated are dependent on the physical properties of water. It is a remarkable fact that within the short range of temperatures on the earth's surface lies the whole gamut of the changes of state in water, with all the consequences which flow from a high specific heat and the liberation and absorption of great latent heats. The atmosphere exhibits climatic contrasts chiefly by reason of its contained moisture. Propelled by the sun's energy from without, water is the chief sculptor of the solid forms upheaved by the earth's energy from within. Without water there would be no agriculture, nor would coal and iron have been deposited for our mines. Even man must earn his living by the sweat of his brow. May we then not re-state our description and say that geography studies the distribution of phenomena within the limits of

the hydrosphere? That statement will hold both physical and human geography.

Now let us question the other half of our definition. What do we mean by the distribution of phenomena? In a pregnant phrase Dr Thring, the famous head master of Uppingham School, once described geography as a study of shapes; and if you include the shapes of circulations that is true, and it explains why visualization is the specifically geographic mode of thought and the map the geographic mode of record. By comparing maps of different kinds of phenomena we interlock our visualized generalizations.

So we attain a description, if not a definition, of geography as the study of the interlocking shapes of solids and circulations within the limits of the hydrosphere. For the construction of our maps we use mathematical co-ordinates—latitude, longitude, altitude; but once we have our maps, the philosophy of our subject can begin. The map of the world is a great achievement of human enterprise and accurate science. The philosophical geographer builds upon it. His methods and his aims are his own. To the agriculturalist it is primarily the chemical and physical constitution of a soil which matters, but to the geographer it is the shape which the space covered by that soil presents on the map. He correlates it with such another shape as that which shows the distribution of a particular type of farming, and seeks the reasons for any differences in the two shapes. That is a geographical mode of research.

So we are led to the great question of philosophical geography: "Why there?" Now there are two orders of answer to the question "Why there?" If a man stand on the top of a mountain, he is there because the rocks hold him up and also because he climbed there. The first answer is dynamic; the second is genetic. It is well to keep the distinction between these two great chapters of philosophical geography clear in the mind.

The distribution of phenomena within the limits of the hydrosphere may be thought of as a dynamic system. A trained imaginative aptitude is necessary to grasp even a small part of the myriadfold balance of solid forms and fluid circulations which constitutes the physical geography of the world at a given moment of time. Therefore we seek to attain the practicable by the study of special regions. But we must ever hark back to the whole world conception. No impingement of a current in the sea upon a cape of land but is an item in the balance of distribution on the whole globe. Alter that impingement, as by slow process it is ever being altered, and you will initiate a change

the pendulum has swung back, and the regional idea is again in the ascendant in England, in no small measure owing to the work of the Geographical Association, a body now of 4000 teachers of geography, which was founded at a meeting held at Oxford in the middle nineties. It was a striking testimony to the newer tendencies when Dr Hogarth, President of the Royal Geographical Society, whose recent death we lament, in so many words assigned the special cultivation of philosophical geography to the Geographical Association.

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The distribution of phenomena within the limits of the hydrosphere may be thought of as a dynamic system. A trained imaginative aptitude is necessary to grasp even a small part of the myriadfold balance of solid forms and fluid circulations which constitutes the physical geography of the world at a given moment of time. Therefore we seek to attain the practicable by the study of special regions. But we must ever hark back to the whole world conception. No impingement of a current in the sea upon a cape of land but is an item in the balance of distribution on the whole globe. Alter that impingement, as by slow process it is ever being altered, and you will initiate a change

which in time will run round the world. Therefore every regional study is in the nature of a first approximation; it requires correction in the light of the whole.

From the dynamic point of view origin is immaterial. The Suez Canal is a strait. Relatively to navigation it performs the function of a strait. So with a harbour; it gives like shelter whether it be due to a coral reef or a breakwater. The eight million people of London are a deposit of humanity like any other association of animals or plants. It is immaterial to the merchant of to-day that London originated as a village. The momentum of the going concern is what he counts on.

When we come to the genetic answer to our question "Why there?" we must distinguish between the purely physical and the physical plus human case. In the latter there is added the change effected by human work. Considerable geographical changes may be effected by numbers of men acting under the impulse of ideas held in common. To a very minor extent ideas are contagious even among animals and lead to action in common, as in the famous instance of the Gadarene swine. In the main, however, it is only among men that thought aforehand achieves geographical changes.

Now the genetic answer involves the consideration of process. I emphasize this point. Pure geography is a study of the present, an analysis and imaginative recomposition of a dynamic system. But process of change is history, which we call geology in the one case cited in the last paragraph and just history in the other case. By common consent, however, the study of the processes of denudation is included in physical geography,—a point to be noted in support of the emphasis which I have just given to the concept of the hydrosphere.

There is however a true historical geography. It involves what the literary people call the historic present. The historical geographer seeks to restore imaginatively the dynamic system of some past moment of time, say, the height of the Roman Empire. He will not be content merely with a statement of changes, as it were corrigenda. He must picture the then lie of the forests and marshes and areas of cultivation if he is to understand the significance of the road and frontier system. Thus the historical geographer should not be merely a specialist historian; he has to bring his own angle of criticism to bear on the historical narrative.

At root then, it seems to me that all pure geography, if we may use a mathematical analogy, involves the effort to analyse a closed dynamic system—closed because the hydrosphere is spherical. Mixed geo-

graphy goes into genetic causes, and necessarily borrows from other sciences such as history and geology.

In this age of flying and wireless telegraphy it may be true that man is no longer cabined and cribbed by geographical obstacles, but it is still true that he conquers nature like an artist by understanding the properties of the material in which he works. More than ever will it be necessary that the next generation should contain men and women with a trained power of geographical imagination. Judgement in large affairs involves just that power of seeing vast masses of detail in orderly relationship and proportion which distinguishes the ideal geographer and the ideal historian, the one in regard to space and the other in regard to time, and both as they exist on this earth's surface. A worthy School of Geography of university rank should be a school of concrete philosophy.

STUDIES AND RESEARCHES ON PREHISTORIC MAN AND HIS ORIGINS

CONTE D. COSTANTINI

Carefully reviewing the records we possess of prehistoric man, it is rather disconcerting to realize how little we know and how little has been done up to the present to further our knowledge on that score; and how no research work has been undertaken anywhere in accordance with a programme scientifically studied in every detail, for the purpose of ascertaining the validity of some of the fundamental laws which bear upon the general interpretation of the great issue. Often, had we followed persistently a chance clue (of which we have found many) with the help of such knowledge as we possess of the phenomena that during the various epochs bore a special significance towards the changes affecting the face of the earth and all manner of life upon our planet, we might have arrived at a more rational and conclusive understanding of certain matters. But I fear that too much time has been spent so far to no other purpose than the collecting of rare specimens in the manner of the archaeological mentality of former days; and most people, satisfied with a few facts, by wild speculation on such data as they casually came to possess tried to serve their mental eagerness and pride with the issuance of verdicts, very learned indeed, but too often not scientifically proved by a direct appeal to the earth's hidden treasure of documents. And their work has been local, piecemeal, mean, and individualistic, simply on

account of their lack of proper vision and, above all, of the needed appreciation and support of others. Until the American Museum of Natural History organized that remarkable expedition which was sent to China and under Roy Chapman Andrews is still searching the Gobi for documentary evidence on the origin of man, nothing, as far as I know, had ever been attempted of such a thorough character and with such a definite and far-reaching purpose.

Whether Asia or Africa has been the cradle of fauna and flora, whether we assume the monogenist theory or not but carefully review the known vicissitudes which caused such fundamental changes on the face of the earth and the distribution of land and water from the earliest geological epochs down to the Quaternary, it seems as if the African continent ever remained the most consistent part of the emerged land, the Eurasian connection being established only during the upper Neogene.

I do not desire at present to enter upon a geophysical or palaeogeographical discussion on the merits of the various charts which have been devised up to date to express those changes graphically, nor to speak of isotherms in different epochs and of bathymetric maps. I am not going to discuss land bridges and former continental areas, nor Wegener's attractive theory. Neither shall I dwell upon all the factors that concur in making a given place best suited to the development of life, such matters entailing a concomitance of innumerable causes and peculiar conditions, known to us only in their extreme manifestations.

But I desire to stress the fact that nowadays, if we wish to give new momentum to the progress of our studies, we must feel that, having reached a great turning-point in the furtherance of our knowledge, we may call upon the organized resources of all men to unite in purpose and in action, lest we desire to mark time on the same ground, trusting only to chance contingencies for advancement. I call for international co-operation, on account of the extremely limited number of scientific men who have specialized in field-work in this many-sided and arduous enterprise—men devoted to the various branches of knowledge which bear upon its vast realm and the correct interpretation of its documents—and, last but not least, on account of the large financial backing necessary to carry out to a finish research and excavation in far away places and sites difficult to approach, entailing a considerable outlay of equipment, time, and talent before tangible results can be obtained.

With our present understanding of the problem, with our ability to interpret nature's language by means of the acquisitions accumu-

lated by hard work in the past, we must now at last seek the whole meaning of the great gospel whose pages are open to experts in recompense for their labour and thought. And the field to be covered in time and space entails no less than hundreds of millennia and the whole surface of the globe torn and distracted as it is by all manner of commotions. Up to date our acquisitions are very few, and those we know with any degree of certainty are mainly matters of detail.

Discarding the earliest geological epochs we might concentrate our attention upon the ages after the Mesozoic which bore a strict relation to the development of mammals—that is the Tertiary—and plan our future programme accordingly. It is of course during those times that man's higher evolution must have taken place; but nothing has yet been discovered in the world to elucidate that question, especially since eoliths have been definitely discarded as products of human industry. The first documents we possess of man as such have been found so far only in Quaternary deposits, the more ancient specimens (excluding the Javanese relics) extending from Rhodesia to England, and from Galilee to Gibraltar.

The ancestral common stock, out of which man and the anthropoid apes evolved into separate branches, lived in the Oligocene; but we still possess very little evidence of that early period and of the various stages in their growth from the main tree. Notwithstanding the documents brought to light through recent discoveries in Asia and Africa formidable breaches still interrupt the continuity of the great chain. And yet, even giving proper consideration to modern biological assumptions regarding the influence of endocrine glands on growth and metabolism and the reactions of germinal glands to certain stimuli, those missing links have been real beings existing through a considerable span of time.

Cuénot and Teilhard expressed the opinion that one of the reasons why such links are so hard to find is owing to the fact that the power of evolution only remained the prerogative of rare and localized specimens and was lost by the more common species. But the first small primates, before they evolved into human beings, must have passed through a long series of phyla, whose power of development was individually increased or exhausted, reaching forms closely resembling man—the height of their evolutionary process—not until all anthropoids had attained their full growth. The remains of anthropoids discovered in the upper Tertiary strata of the Siwalik Hills in Asia, or the relics of the Miocene of Europe and of the Oligocene of Faiyum, serve to show that simians much nearer to man than the modern gorilla or

chimpanzee lived in those early days. And it is to their group that very likely belongs the famous Australopithecus of Taungs, which seems to have lived on the brains of other monkeys, extracted from their skulls by means of careful trepanning.

But we do not yet possess any valid document, neither bones, nor artifacts, proving that man, as such, lived during that epoch. Except for unforeseen circumstances, for a long time to come we may have to be satisfied to search chiefly for the products of man's industry, because their hard material is more likely to have been able to withstand the test of time than perishable bones.

Europe, maybe, never enjoyed in those distant epochs the peculiar conditions that would have been necessary to further the evolution of the primates up to man's full stature. But the human species seems to have migrated on the Continent only after it had obtained its highest development and a remarkable degree of skill. According to the latest finds of Abbé Henri Bréuil in the 60 m. terrace of the valley of the Garonne and in the English glacial deposits, that event must have occurred prior to the Mindel glaciation.

It is geology and palaeogeography that will help us to solve the problem, providing us with the fundamental draught for a well-thought-out plan of investigation. And I take great pleasure in submitting to your thoughtful consideration the advisability of promoting the study of a complete series of maps drawn as a guide to prospectors in this field, worked out in accordance with the latest evidence we possess of palaeogeography and corroborated by geophysical, palaeoclimatical, and palaeontological data, in order that we may offer the world a thoroughly scientific guide for the rational pursuance of future research work. The Commission on Pliocene and Pleistocene Terraces has stressed the advisability of publishing a map of marine platforms, shores, and terraces and of river terraces. But such a map would represent only one phase of the whole subject. The charts which I propose should be the practical means of directing scientific endeavour and public opinion, showing the safest road that all may follow in a great co-operative effort, in order that through a comprehensive review of what has been achieved and a clear perspective of what ought to be done to reach our goal we may seek for the data we need to write the unwritten pages of man's history upon our planet. Because, if we are not certain where and how land stood during the various epochs whose history we mean to retrace, if we do not consider what parts of the emerged land were best suited in those times to the development, wanderings, and habitat of living beings, how

shall we determine the right path to be chosen for the realization of an exhaustive plan of future research?

France has been explored more thoroughly and completely than any other country up to date; and it is more or less upon French material that the modern study of human prehistoric existence has been founded. But France, like any other country, can only tell her own tale. And those discoveries, if examined individually, cannot give us the comprehensive history of the whole Continent, whose different parts have passed through peculiar vicissitudes of their own, no more than we could manage to explain their past by a review of Scandinavia alone and its neolithic remains.

Until the whole of Europe and Italy and all the territories round the Mediterranean are thoroughly searched, we shall not be safe in accepting too facile generalizations such as are now prevailing, which may be no better than some of Cuvier's fantastic reconstructions out of a few bits of fossil relics, sometimes of very doubtful significance. Very little indeed has been done so far round the Mediterranean basin, which must nevertheless have played a very important part in relation to man's advent in Europe, especially during the last phases of its final readjustment before and during the Quaternary. And, as we know, its modern geographical structure is the result of the great Neogene crisis which is not yet completely over.

Something has been accomplished in Italy of course since Scarabelli first published in 1850 his "Antediluvian" discoveries of Imola. English, French, Germans, and Italians worked in turn on the Peninsula; but no systematic work was ever undertaken there until recent years, and nothing comprehensive on that region had ever been published till Vaufrey lately issued his short but valuable essay in the *Archives* of the "Institut de Paléontologie Humaine" of Paris.

The Italian Chellean civilization is still a mystery in respect of its origin; and so far it has only been found round the calcareous formations of the Apennines. Nor do we know any better where the Mousterians may have come from, nor what may have been their relation to similar industrial activity in the rest of Europe; nor whence came the Aurignacians; nor whether these successive stages have been the result of an autochthonous evolution. And where did the negroids or australoids found at Grimaldi come from—those negroids whose characteristics are not lost even to-day among certain European and Asiatic peoples? What is that Olmo skull which was found by Cocchi in 1863? Is it actually the cranium of a Neanderthaloid female? Is Italy jealously keeping hidden within its folds the fossil remains of

some unknown representative of an even earlier civilization? The three great palaeolithic periods have left their characteristic imprints on the Peninsula; but where did those men come from—the north-east, the north-west, or the south? These are only a few of the incognita that are still matters of speculation and that we must find the best means of answering, because they are affecting the study of prehistoric man in all parts of the world.

France, through the generous intervention of Prince Albert of Monaco, has long since established a great central institution for the study of human palaeontology, distinguished by the untiring devotion of men such as Marcelin Boule and the Abbé Henri Bréuil. Italy earnestly followed this great example; and the Italian Institute of Human Palaeontology was founded in 1926 in Florence at the National Museum of Anthropology and Ethnology of that University. It accepted the inheritance of a precarious, if glorious past, and set to work to put its house in order, with the ambitious programme of completing the work that had gone before and of organizing anew an extensive campaign of systematic investigation. It started under the guidance of representative men, each one of them of repute in the various specializations which are concomitant to the issue, elected by well-known cultural institutions such as the "Institut de Paléontologie Humaine" of Paris, the Italian Department of Public Education, the Science Department of the University of Florence, the Italian Institute for the Progress of Science, the Italian Archaeological Institute, and the Italian Institute of Anthropology and Ethnology. It is its purpose to give the country's full contribution to the study of man's prehistoric past, such as was keenly desired by all, with a view to the solution of some of the incognita which bear upon the very fundamentals of the science.

Thus France and Italy are ready to give their full share to the common cause. Let others follow. Because, as I have already said, if we desire to secure far-reaching results, we shall have to work out some consistent plan of activity by international agreement and co-operation, in accordance with which the divided individualistic efforts of the few may be directed to a comprehensive unity of purpose for all. I beg you, gentlemen, to take the opportunity of appointing an International Executive Committee composed of representative men chosen from each country in each field of knowledge concerned, who may devise the best means of furthering a general programme of future research, upon which we may build our edifice with the least possible waste of wealth, time, and talent.

SIR HALFORD MACKINDER invited discussion on the proposal to form an international committee for the study of human palaeontology. He referred to the great advances originating from individuals but also to the need of a committee for standardizing nomenclature and assisting correlation.

PROF. R. BIASUTTI rappelle l'assemblée que l'idée de l'établissement de cartes géologiques et paléogéographiques pour servir à la plus ancienne préhistoire de l'homme était déjà partie, il y a quelques années, de la France et que la cartographie archéologique a eu plusieurs applications aussi en Angleterre. Il croit qu'un travail utile puisse être organisé et propose la nomination d'une commission de section pour définir exactement le but de la recherche et pour considérer l'opportunité de la constitution d'une commission du Congrès.

MAJOR G. G. AITKEN remarked that British Columbia geographers were not specially interested in the past of man except as supplying the background for the present. The past and present together supplied the data for indicating the direction of future policy. In view of a mass of "early man" data being discovered he suggested that a small economic research committee, with powers to extend its scope to present and future economic geography, should be established as a "Report Centre" to collect and record all outstanding data.

SIR HALFORD MACKINDER suggested an informal conference between Conte D. Costantini, Dr H. Ami, and Prof. H. J. Fleure to see what could be arranged. [See *Commission No.* 6, p. 46.]

CITIES OF JAPAN

PROF. Y. NISHIDA

In Japan a town is officially called *Shi* when that town has a population of 25,000 or more and is recognized by a law called *Shisei*, that is, the Municipal Corporation Act. I shall translate *shi* by "city." A small town, which is a local commercial centre, is called *machi* or *cho*, and has usually between 2000 and 25,000 inhabitants. But there is no distinction in law between the population of a town and a village; the latter may be as large as that of a town.

According to the first census taken in 1920 there were 83 cities in Japan proper, which includes four main islands—Honshu, Hokkaido, Kyushu, and Shikoku; and the total population of these cities was 18 per cent. of the total population of Japan proper.

In the next census taken in 1925 the number of cities increased to 101, and the percentage of their population was 21·6. Among these 101 cities, 21 cities had over 100,000 inhabitants (including two great cities, Tokyo and Osaka, each of which had some 2,000,000 inhabitants), 34 cities between 100,000 and 50,000 inhabitants, and 46 cities between 50,000 and 25,000 inhabitants.

In 1889, when the Municipal Corporation Act became operative, there were only 29 cities in all, and the percentage of their population was only 9·4. Therefore you will see that the concentration of population into cities is a notable feature of modern Japan.

As to the distribution of these cities, I may make the following observations:

(1) Topographically, every city is situated on a coastal plain or in an inland basin; all the great cities except Kyoto are on coastal plains.

(2) As Honshu bends suddenly to the northward at nearly 37° N. lat., climatic conditions differ between north-eastern Japan and south-western Japan. From the tectonic point of view it is considered that the dividing line between north-eastern Japan and south-western Japan is Fuji Tai or *Fossa Magna* (according to Dr Naumann); but from the standpoint of human geography that line must be taken along the 37° N. lat. In south-western Japan there was even in ancient times a rapid expansion of Japanese people from the south-westward; but at the turning point to the north its expansion was suspended for a long period. That is the reason why north-eastern Japan has not so many cities as south-western Japan.

(3) In Honshu, there are many cities on the Pacific slope compared with the opposite slope towards the Sea of Japan. The cause of this is generally considered to be climatic influence. The Pacific slope has a climate like that of any other monsoon region of south-eastern Asia, namely, dry in the hot season and wet in the cool season; but, owing to the influence of a warm oceanic current and a north-west wind prevailing in winter, the slope towards the Sea of Japan has a wet season even in winter. On the Pacific slope, there are grouped many cities on the three main coasts. Namely (*a*) on the coast of Tokyo Bay, there is Tokyo; (*b*) on the coast of Ise Bay, there is Nagoya, the third greatest city in Japan with some 800,000 inhabitants; and (*c*) on the coast of Seto-uchi, the Inland Sea, which is famous for its scenery and its geotectonics, there are Osaka and Kobe, the latter having about 700,000 inhabitants. The above-mentioned seas are calm throughout the year.

(4) In Kyushu there are many cities in the north-western district, because this part of the island is situated facing the continent of Asia, from which eastern civilization has been introduced for many centuries and for the last 300 years western civilization has also come. Moreover, in this district some new industrial cities have developed during the last 40 years, owing to the rapid progress of the coal-mining industry.

(5) Again, in Hokkaido, there are many cities in the western part of the island. The reason for this also is explained mainly by its situation; for the island has been inhabited in recent years by Japanese people from the southern islands. Of course, the leading topographical feature of Hokkaido, namely, the main mountain ranges lying north and south across the middle of the island, must also be taken into consideration.

Now, from the embryological point of view, namely that of the foundation of cities, I shall try to classify the above-mentioned 101 cities in six categories:

(1) Cities as centres of administration or defence.
(2) Cities as commercial centres.
(3) Cities as centres of communication and transport.
(4) Cities as manufacturing centres.
(5) Cities as religious centres.
(6) Cities as pleasure resorts.

Of course, these six groups of cities have each their special features, according to their different functions, and in the course of time they have changed their functions or increased their complexities. First I shall tell you briefly the history of cities in Japan proper, and then I shall explain the special features of these six groups of cities.

There were only a few cities in Japan proper about 400 years ago, when the feudal system had been developed. Before that time there were only a capital city and a few harbour-towns. Though the feudal system was founded in A.D. 1192, it was not then so powerful as it became by the end of the fourteenth century. In the fifteenth century there were many wars everywhere between the dukes; hence we used to call that age *Sengoku-jidai*, namely, the War Age, which may be compared with the Dark Ages in European history. At that time each duke, who governed any district on a coastal plain or in an inland basin, protected himself with a strong fortified castle called *shiro*. Round the castle there resided a group of the duke's subjects; and some common people also lived with them to supply them with food and other necessities of life. This is the origin of the *Jokamachi* or castle-town. These can be compared with any castle-town in Europe, but with this difference, that, while a European town was almost always completely surrounded by a wall, in the *Jokamachi* only the duke's castle was fortified.

After this dark age there followed the *Edo* era, so called because, though the emperor was reigning nominally in Kyoto, Edo, now Tokyo, was the real political centre of Japan. For in Edo there was

the *Shogun*, or supreme commander of all dukes in Japan; and each of these dukes resided in one of the large local towns, ruling over the surrounding country. This peaceful epoch of the feudal system continued for about 270 years. In this era many industries, though very small in scale, flourished throughout Japan, accompanied by regulation of the transport, communication, and commercial systems. Thus each *Jokamachi* developed gradually. Many sea-port towns and *Shikubamachi*, or local centres of transport, were also rising. Of course Edo was much more flourishing than Kyoto, and its population was estimated at over one million.

This feudal system was broken up owing to two causes. One of them was an internal cause—the corruption of the system by the long-continued peace. The other was an external cause—the open door of Japan, which resulted from the visit of Commodore Perry, U.S.N., in 1853. Then followed the great reformation of the *Meiji* era, and western civilization was again introduced very quickly. Towns in Japan could not escape from this influence. Every *Jokamachi* had been left to decay by the retreat of its duke and his subjects, but gradually was rejuvenated more or less according to the degree of its adaptability to these changes in social conditions. On the other hand, owing to the development of foreign trade, the harbours which it frequented increased in number and population; and among these Yokohama and Kobe made the most rapid progress. At the same time, defence was re-organized. Although the armies were nearly all distributed among the main *Jokamachi* or castle-towns, naval bases were now established on the important coasts; Yokosuga, Kure, and Sasebo are the most noteworthy of these. Mining industry too was renewed on a large scale, and mining and industrial centres grew into cities. Omuda and Yawata in north Kyushu are the best examples.

Although the cities which are religious centres, such as Ujiyamada, where the most famous shrines *Ise Jingu* are, and Nagano, where a famous Buddhist temple stands, have their origin in ancient times, their development dates from the *Edo* era, because in that peaceful age the custom of pilgrimage prevailed, and has continued ever since on a large scale.

The development of cities as pleasure resorts dates from the *Meiji* era; Beppu in east Kyushu, one of the famous hot-spring resorts, is the best example.

I shall now discuss the six special types of cities.

(1) *Cities as centres of administration or defence*

In this case, I can subdivide the group into four, namely:

(*a*) The capital.
(*b*) *Jokamachi* or castle-towns.
(*c*) Naval bases.
(*d*) Local administrative centres.

(*a*) *The capital.*

Kyoto is an example of this, as the emperors abode there for over 1000 years. Its plan was modelled on the Chinese capital city Changan, now Sian, in Shensi province, and was like that of any Chinese town. A wall, not so gigantic in the case of Kyoto, surrounded the rectangular city, and the streets crossed each other at right angles. But to-day Kyoto has no wall, and the ancient features remain only in its western part. In recent years it has been enlarged by the growth of its suburbs.

(*b*) Jokamachi *or castle-towns.*

These are the most interesting city types. Every *Jokamachi* was constructed round a duke's residence, which was fortified with piles of huge stones and surrounded by deep moats; but the town itself was usually outside the defence, except a few examples which were surrounded by moats or partially girt by rivers, sometimes by the sea. Its street was almost always constructed in the shape of the letter T, to prevent a clear view through the town.

Tokyo, now the capital, was called Edo before the *Meiji* era, and was founded about 300 years ago. In the beginning it was only a small *Jokamachi*, but throughout the Edo era the *Shogun*, the supreme commander of all dukes in Japan, resided in this town. It was therefore the real political centre of Japan, and it gradually grew into the largest town. From the *Meiji* era onwards it has been the capital of the emperors; and the modern rapid progress of everything in Japan has made it very much larger. Greater Tokyo, which includes administrative Tokyo and its suburbs, has about three million inhabitants.

(*c*) *Naval bases.*

Yokosuka is at the entrance of Tokyo Bay, Kure stands in a central position on the north shore of Seto-uchi, the Inland Sea, and Sasebo is in the north-western part of Kyushu. These three cities, having about 100,000 inhabitants each, are important naval bases. Each city

has a main quarter for the naval establishment, and there are other quarters for commerce and residence.

(*d*) *Local administrative centres.*

When a local administrative centre is established in a small town, it grows gradually into a city, not only as a political centre but also as the local centre of commerce, transport, industry, and intellectual activity. Such a city has an administrative quarter in its main part; and adjoining it there are intellectual, residential, commercial, industrial, and transport quarters. Miyazaki in Kyushu is an example.

(2) *Cities as commercial centres*

In this case, I can subdivide the group into two: (*a*) *Ichibamachi* or market towns, and (*b*) harbour towns.

(*a*) Ichibamachi *or market towns.*

As in other countries, Japanese internal trade was once carried on by a system of fairs. It continued from ancient times to the *Edo* era. Then the centres of fairs gradually grew into towns. These are called *Ichibamachi* or market towns. Some examples still have a wide market-place in the main street. Certain of these towns grew into cities. Yokkaichi is an example. The city's name, Yokkaichi, means the fair of the 4th days, because the fair was opened three times in every month, on the 4th, the 14th and the 24th days. This city was founded as a little *Jokamachi*; but its development was due to the fair, and it now flourishes as a harbour for foreign trade and as a local centre of commerce and manufacture.

(*b*) *Harbour towns.*

Certain of the harbour towns were already in existence in ancient times, but they were few in number and small in population. But some of them grew into large towns, and many towns were newly founded in the *Edo* era. Osaka is an example. Though it was founded as a *Jokamachi*, through the *Edo* era it grew into the most important commercial harbour. Since the *Meiji* era it has developed into one of the greatest cities in Japan, not only as a centre of internal and international trade, but as a centre of industry and transport. Its population is estimated at over two million. Yokohama was founded about 70 years ago, and has developed rapidly. In the case of Kobe, Hyogo, its southern part, was a harbour more than 1000 years ago; but the adjacent north-eastern part, which is the main part of Kobe harbour to-day, has developed in the last 70 years.

(3) *Cities as centres of communication and transport*

In the *Edo* era owing to the development of inland transport many towns were founded along the main roads as transport centres. These towns are called *Shikubamachi*. The most famous examples of them were the *Tokaido-gojusantsugi*, 53 stations along the main road *Tokaido*. This road connected Edo, now Tokyo, and Kyoto; and along it there were 53 stations at a distance of 7 to 10 miles from each other. But owing to the sudden change of the inland transport system in the *Meiji* era, namely, the change from road-transport to railway-transport, these towns almost all decayed; but some of them yet flourish by having changed their functions. Numazu is an example. This city is situated on the road *Tokaido*, and now flourishes not only as a railway centre but also as a local commercial and industrial centre, and moreover as a pleasure resort.

(4) *Cities as manufacturing centres*

The great cities usually have manufacturing quarters in their suburbs. The north, east, and south suburbs of Tokyo and the north and west parts of Osaka are examples of them. Nagoya, the third greatest city, was founded as a *Jokamachi* or castle town about 300 years ago; but many great factories have been established in its south and west parts during recent years. Nishinomiya, near Kobe, has developed on account of the brewing of *sake*, a kind of Japanese wine, though in origin it was a *monzencho*, which I shall explain shortly. Since the *Meiji* era, the coal-mining industry has flourished here and there. Many towns were founded in the vicinity of mines. Ube is an example, and this city has also some factories. Omuta and Yawata in north Kyushu are other examples; they became manufacturing centres owing to the proximity of the coal-fields.

(5) *Cities as religious centres*

Shrines and temples in Japan usually attract people to settle in front of them. These towns are called *Monzencho*. They may be compared with the church towns in Europe. Ujiyamada, which has two famous shrines, and Nagano, which has a famous temple, are examples.

(6) *Cities as pleasure resorts*

This group contains two subdivisions: (*a*) tourist resorts, (*b*) health resorts.

(*a*) *Tourist resorts.*

As an example, Nara, near Kyoto, may be taken. This city was an ancient capital for some 70 years. But on the removal of the capital to Kyoto this town soon decayed, except for some temples and shrines. In front of them afterwards there arose a *Monzencho* at the eastern suburb of this ancient capital. In recent years it has attracted many tourists by its historical remains and its scenery. This city is also a centre for the Nara basin.

(*b*) *Health resorts.*

Beppu in east Kyushu is an example. In the vicinity of this town is one of the famous hot-spring districts. Kamakura, near Yokohama, was once a real political centre in Japan—for some 130 years the Shogun's residence. After the fall of this Shogunate the town was left to decay; but it has been rejuvenated in recent years as a health resort for its climate.

In the new territories of Japan, namely, Chosen (Korea), Taiwan (Formosa), and Karafuto (South Sakhalin), the cities must be regarded from other standpoints.

In Chosen, which has an area equal to that of Honshu, there were only seven towns in 1920, and ten in 1925. These towns each had a population of over 25,000 inhabitants. Even Keijo (Seoul), which was the largest and the capital in this peninsula, had only 340,000 inhabitants. The reason of the scarcity of large towns is that the economic life of the Koreans is limited almost entirely to primitive industries. As Chosen is a mountainous peninsula, these towns are distributed along the river plains or on the coastal flats. The towns, except the principal harbours, are surrounded by walls like any Chinese town. The principal harbours have been founded in recent years by the Japanese.

Next, Taiwan, which in area is equal to Kyushu, has also very few towns, namely, nine in 1920, and ten in 1925. Each of these towns had over 25,000 inhabitants. Even Taihoku, the largest town in this island, had only 200,000 inhabitants. The reason of the scarcity of large towns is considered to be the same as in Chosen. The towns are

distributed in the western plain on account of its topography and situation. By situation I mean that the majority of the inhabitants of this island are Chinese and their ancestors came from south China, the land opposite to Taiwan. The leading feature of the towns is therefore their Chinese type; but the walls have been almost destroyed in recent years.

Lastly, in Karafuto, which in area is equal to Kyushu or Taiwan, there was only one town which had a population over 25,000 in 1925. This island has few inhabitants—only about 200,000 in all, including some 2000 natives. The majority of the inhabitants have come to settle from the southern islands of Japan since 1905. The cause of the scarcity of towns in this island is mainly the situation and climate.

L'ÉCOLOGIE DE L'HOMME

PROF. M. SORRE

Other work: *L'Organisme humain et le Milieu biologique naturel: Bulletin de la Société de Géographie de Lille*, 1926, 68, pp. 105–13, 146–61.

I

Le mouvement de réaction qui s'est produit à la fin du siècle passé et au commencement de celui-ci contre les idées anciennes touchant les causes de la distribution des grandes endémies tropicales paraît avoir eu pour résultat de faire abandonner momentanément dans quelques pays, sinon partout, une part importante de la géographie humaine. Il est au reste certain que le nom même de géographie médicale attribué longtemps à l'étude des rapports entre l'organisme humain et le milieu géographique était beaucoup trop étroit et que l'on ne gagnera rien à le ressusciter. Pourtant ces rapports entre l'organisme humain et le milieu géographique existent. Notre environnement exerce sur nous une pression continue qui se traduit pour l'expérience courante par des crises pathologiques. Mais elle peut aussi s'exprimer par des actions plus directes, plus cachées, plus durables. Nous voyons, dans tous les pays, des physiologistes se consacrer à l'étude des relations entre les variations des éléments climatiques et les changements dans le métabolisme, dans toutes les fonctions, dans la morphologie même de l'homme sain et non plus seulement de l'homme malade. Une masse énorme de renseignements s'accumule au sujet des limitations que l'activité des organismes microbiens met à la multiplication des hommes, au plein développement

de leur activité. Il est clair que la géographie humaine ne peut plus se borner à traiter ces phénomènes par rencontre et, si je puis dire, par prétérition. Elle limiterait singulièrement son domaine et s'exposerait, je le crois, à de graves mécomptes si, consacrant tout son effort aux formes les plus élevées de l'activité humaine, elle laissait de côté les formes primitives et essentielles qui constituent l'activité organique. Tout le matériel amassé depuis trois générations nous permet aujourd'hui de considérer méthodiquement les rapports de l'organisme humain avec son milieu, autrement dit et pour appeler les choses par leur nom, de tenter de tracer les cadres de l'écologie spécifique de l'homme.

II

Il est bien remarquable que des réquisitoires violents aient été écrits contre l'ancienne géographie médicale au moment même où la notion de milieu se transformait, où les grands facteurs qui constituent l'environnement changeaient pour ainsi dire de plan, c'est-à-dire entre 1890 et 1910. Le premier terme de l'équation où se résume le problème écologique, le milieu, paraissait désormais indéterminé. Le second terme, l'organisme, devait perdre aussi son apparente simplicité lorsque les fonctions des glandes endocrines entrèrent en jeu. Mais bien des choses aujourd'hui se sont mises à leur place. Si nous pouvons aborder de nouveau la question, non pour la résoudre, tout au moins pour montrer comment elle se pose, c'est que nous sommes à même de donner une définition plus compréhensive du milieu géographique par rapport à l'organisme humain. Je ne saurais avoir l'ambition de traiter ici tous les problèmes de méthode: ils sont nombreux et complexes. Certains d'entre eux ne pourraient être traités fructueusement qu'en collaboration avec nos collègues des Sections de biologie et de climatologie. Je me bornerai à esquisser les grandes lignes de la constitution du milieu géographique.

III

Une première catégorie de facteurs correspond au climat. Il y en a qui sont depuis longtemps reconnus comme susceptibles d'affecter l'organisme par leurs variations, encore que le mécanisme de cette action soit souvent obscur. Tels sont la pression barométrique ou plutôt la tension des gaz de l'atmosphère, la chaleur, l'humidité, le vent. Mais il en existe d'autres. Toutes les formes de l'énergie rayonnante, même celles qui ne sont pas perçues par nos sens, sont à considérer. Or la chaleur et la pression sont les deux seuls facteurs dont la distribution géographique soit à peu près connue. Il existe une foule de radiations qui ont leurs qualités propres, que les pro-

cédés de laboratoire nous permettent à peine d'isoler. Nous n'avons que des renseignements encore très grossiers sur leur répartition dans les couches de l'atmosphère. Nous ne pouvons rien dire de sûr touchant leur répartition géographique. Il y a là un vaste champ pour la climatologie. Il ne sera sans doute complètement défriché que moyennant une transformation des méthodes de la climatologie. On peut attendre beaucoup de la collaboration des biologistes avec ceux qui s'occupent de météorologie. Mais de toute évidence, les premiers doivent fournir le programme d'observations.

IV

Surtout dans les régions chaudes, l'action prépondérante appartient au milieu vivant. Il se forme dans la nature des associations d'êtres à tous les degrés de l'organisation, vivant les uns sur les autres, aux dépens les uns des autres, où l'homme est engagé. Le parasitisme est le lien de ces complexes biologiques. Pour prendre un exemple concret, des rapports étroits se sont établis entre des hématozoaires du genre Plasmodium, diverses espèces de moustiques appartenant au genre anophèle et l'homme. D'autres espèces animales peuvent d'ailleurs se substituer à l'homme (bovins). Et dans ce complexe peuvent aussi entrer des poissons qui se nourrissent de moustiques et même des végétaux aquatiques dont la présence favorise le développement des anophèles. Nous disons que ce complexe est un complexe pathogène parce que la multiplication des plasmodes dans le sang humain est la cause de la malaria. Le jeu de ces groupements, leurs conditions d'équilibre interne, leurs nécessités écologiques règlent la distribution des endémies, l'intensité de la morbidité, de la mortalité dans de vastes contrées. Il n'est pas certain que leur activité n'ait pas eu par un effet d'accumulation une action plus cachée et plus profonde sur les races. Toute l'étude de l'action du milieu vivant repose sur cette notion fondamentale de complexe pathogène.

V

Enfin, une dernière série de circonstances géographiques peut être isolée. Ce sont celles qui ont trait à la vie sociale. Quand on réflechit à l'influence profonde et si souvent marquée par les zoologistes de la domestication sur les espèces animales, on se trouve tout préparé à admettre l'action de la vie sociale sur l'organisme humain lui-même. Ce n'est pas seulement pour les sociologues et les moralistes que l'homme est un animal social. Peut-être hésitera-t-on à invoquer l'influence morphogène de la répétition de certains gestes, de certaines attitudes. Il est devenu difficile de parler de l'usage des parties. Il n'en

est pas moins vrai que la densité des hommes, que le fait pour eux de vivre groupés dans des villes, que les contingences de la vie de relations, le stade de civilisation ont une action sur leur morbidité, leur mortalité, leur multiplication. Est-ce qu'il n'y a pas une différence entre les ressources nerveuses d'un habitant des villes et celles d'un habitant des campagnes? La vie urbaine modèle les individus avec une inconcevable puissance. Toute la somme des habitudes qu'impliquent la recherche de la nourriture et l'habitat et que consolide la vie sociale, pèse d'un poids énorme sur notre passé. Toutes ces circonstances anthropogéographiques se cristallisent autour de la notion de genre de vie qui prend pour cette partie de l'écologie humaine la même importance que celle de complexe pathogène pour la précédente.

VI

C'est par pur artifice, et parce que nous ne pouvons pas faire autrement que nous décomposons ainsi le milieu géographique. Tout se tient dans la nature. Les facteurs énumérés plus haut agissent en même temps. Ils agissent les uns à travers les autres: l'activité des complexes pathogènes, sinon leur formation, dépend pour une grande part des conditions de climat. Il arrive parfois qu'ils se contrarient. Nous soupçonnons que certaines groupes de radiations peuvent se neutraliser (infra rouge et ultra violet). A un stade avancé de civilisation, par des mesures d'assainissement, un groupe humain peut annuler les effets du milieu naturel. On ne saurait trop insister sur ce point: rien n'est plus compliqué que le déterminisme géographique dans ce domaine. L'étude écologique est astreinte à diversifier ses méthodes à assouplir ses points de vue pour ne rien laisser échapper de la complexité des choses.

Nous n'avons pas exposé un programme dans cette brève communication. Seulement un point de départ. Peut-être a-t-on entrevu l'intérêt du problème. Il réclame bien des collaborations. Nous souhaiterions qu'il fût inscrit au programme des travaux du prochain Congrès. D'ici là nous espérons avoir fait paraître une étude préliminaire qui pourrait servir de base de discussion.

SIR HALFORD MACKINDER thought that Prof. Sorre had very usefully drawn their attention to the change in the medical point of view from the mere cure of disease to the preservation of health. An atlas showing the conditions of living in various regions would be very valuable but very difficult to construct. It would be necessary, for instance, to devise some method of recording the fact that Londoners in winter ate New Zealand butter containing the vitamins produced in the summer of the southern hemisphere. Hence he considered that Prof. Sorre had done well in contenting himself with ventilating the subject on this occasion.

SOME PROBLEMS OF THE POPULATION OF EGYPT

PROF. MUSTAFA AMER

See *Annexes to the Report of the Egyptian Delegates to the Geographical Congress, Cambridge*, 1928, *No.* 5*: Survey of Egypt*, 1929, 28 pp.

Abstract

Various factors control the distribution of the population of Egypt, the most important of which is the problem of the water supply. The Nile is Egypt's sole source of existence, supplying it with soil for its agriculture and water for its crops. The density of the population crowded beside the river is unknown in any other country. The Delta contains a larger and more irregularly distributed population than the part of the valley above Cairo.

A large proportion of the population is agricultural, though this proportion tends to decrease (41·4 per cent. in 1897, 31·4 per cent. in 1917). The numbers of those engaged in industry increase very slowly, while figures for those engaged on the extraction of minerals show an absolute decrease. The change from the old basin system of irrigation to the perennial system has meant, for Egypt, a real economic and social revolution, and has made her wholly dependent on, and at the mercy of, a single crop, cotton. As this grew in importance food crops have fallen short of the inhabitants' requirements, and Egypt now imports foodstuffs. The urban population is growing more rapidly than the rural, though the phenomenon of emigration from rural to urban districts does not exist. The percentage increase of rural population at the Census of 1927 was 7 per cent., that of urban population 35 per cent.

The growth of the total population has been remarkably rapid (2,460,000 in 1800, 6,831,131 in 1882, and 14,168,756 in 1927). This is a greater rate of increase than that of Belgium, the United Kingdom, or Germany, and is only exceeded by that of the United States. Owing to limited space, the density of the population is increasing rapidly, and though it is estimated that by reclamation of waste land, etc. the cultivated area can be increased from 5,200,000 to 7,000,000 Feddans, the population continues to increase at 250,000 per annum. It is estimated that this will fill the available land by the seventies of this century, and the problem of its disposal after that date remains unsolved. Foreigners make up only 1·6 per cent. of the population, and most of the wealth of the country is held by Egyptians.

H. SIRRY BEY invited members of the audience to examine the new *Atlas of Egypt* published by the Survey of Egypt, Giza, 1928, which was being exhibited in the main hall of the Arts School, as the economic maps and diagrams with the descriptive notes illustrated Prof. Amer's paper. Plate XXIII was a general economic map, while density of population was shown in XXIV and XXV, density of cotton cultivation in XXVI and XXVII, value of agricultural raw materials in XXVIII and XXIX, and areas of crops and cultivated lands in XXX and XXXI.

DR M. AWAD said that one of the important problems in connection with the population of Egypt was its alleged fluctuation throughout history. This question might not be peculiar to Egypt, but it was easily illustrated by Egyptian history. At the time of the Arab conquest of Egypt in A.D. 640 the population, estimated by the account of the taxation at that time, was somewhere between 10 and 20 millions. At the beginning of the nineteenth century it was in the neighbourhood of 3 or 4 millions. At present it was just over 14 millions. It would be interesting to discover the cause or causes of this great fluctuation.

REV. M. J. STEWART suggested that the relative decrease of the rural population and of the males occupied in agriculture might be accounted for by an increase of rent for farm-lands, amounting to fifteen- or fifty-fold during the period since 1882, according to the information given to him in Egypt when inquiring the cause of the desperate poverty evident among urban masses.

20 JULY

UN TYPE DE PEUPLEMENT DISPERSÉ EN SLOVAQUIE

PROF. P. DEFFONTAINES

To be published in a second *Report of the Commission on Types of Rural Settlement, Rapport de la Commission de l'Habitat rural: Union Géographique Internationale*, 193–, No. — .

For illustrations see *Contribution à l'étude du peuplement en Slovaquie: communes et "Kopanice"*: J. Hansak, *La Géographie*, 1929, 51, pp. 49–67.

Other work: *Les Types de la Vie montagnarde en Tchécoslovaquie: La Géographie*, 1927, 48, pp. 171–7.

Résumé

Dans toute la Slovaquie, le peuplement normal est un peuplement groupé, soit villages allongés en une longue rue à ruisseau central et à maisons séparées et perpendiculaires à la rue, soit villages de type hongrois, allongés aussi, mais à maisons contiguës et à façades parallèles à la rue, soit villages nodulaires composés de deux agglomérations séparées, l'une pour les habitations, l'autre pour les granges.

Mais il existe en outre des îlots de peuplement dispersé tout à fait anormaux dans cette Europe centrale vouée au peuplement groupé; ce sont les "Lazy" ou "kopanice." Ces fermes séparées se rencontrent dans tous les coins de difficile accès qui leur ont servi de zones de refuge: région de Detva, de Krupina, de Bojnice et surtout à la

frontière de la Slovaquie et de la Moravie, dans ce qu'on appelle "la Valachie morave." Ces zones de peuplement dispersé comportent un genre de vie très différent de celui des villages groupés d'alentour. On y pratique un genre de vie surtout pastorale, on y reconnaît des indices de l'ancien système de la "Zadruga," les costumes sont valaques et la langue slovaque compte encore beaucoup de termes roumains pour tout ce qui concerne la vie pastorale. On se trouve devant un peuplement d'origine roumaine qui a assuré l'exploitation des pentes boisées par un système de clairières pour pâturages. Les Slovaques n'étaient pas des pasteurs et des montagnards; ce sont les bergers valaques qui sont venus par îlots entamer la conquête de la montagne au moyen d'un genre de vie qui leur est propre et qui a commencé sans doute par être nomade à l'origine pour ensuite se sédentariser.

SIR HALFORD MACKINDER, in thanking Prof. Deffontaines for the admirably clear exposition of his interesting theme, pointed out the importance of his research in making more precise our knowledge of the results from the Roman penetration in search of gold into Dacia and Transylvania and the subsequent dispersal of the Romanized pastoral Vlachs.

PROF. V. ŠVAMBERA thanked Prof. Deffontaines for his interest in the geography of Czechoslovakia.

THE DISTRIBUTION OF THE POPULATION OF DENMARK

PROF. M. VAHL

To be published in a second *Report of the Commission on Types of Rural Settlement, Rapport de la Commission de l'Habitat rural: Union Géographique Internationale*, 193–, No. —.

Abstract

One of the two maps which I have the honour to show represents the density of the farming population. As might be expected, it indicates that the greatest density is found on the islands and in eastern Jutland where the soil is most fertile. When investigated in detail, however, it proves that the density of the farming population is by no means everywhere proportional to the fertility of the soil. In order to find the causes of this I have limited my investigations to the Danish islands and the south-eastern part of Jutland, where the soil is chiefly boulder clay and the fertility only varies within rather narrow limits. Here it appears from the table given below that the density of the farming

population is least in those districts where the area covered by forest is greatest.

Forests			Farming population per sq. km.
0–5	per cent. of the area		35
5–10	,,	,,	34
10–15	,,	,,	32
Exceeding 15	,,	,,	30

The second factor which is of importance to the density of the farming population is the size of the estates and farms.

Farms of more than 50 tons of hartkorn (about 5 ha)			Farming population per sq. km.
0	per cent. of the area		41
0–20	,,	,,	36
20–40	,,	,,	33
40–60	,,	,,	32
60–100	,,	,,	27

Homesteads of less than 2 tons of hartkorn per cent. of the area	Farming population per sq. km. of arable land
5–10	34
10–15	38
15–20	39
20–25	42
More than 25	50

It is thus proved that the large estates or farms, the owners of which employ a large number of farm labourers, provide a livelihood for a far smaller number of people than the small holdings, where the work is done by the owner himself and his family for the greater part without any hired labour.

The second map shows the industrial population in percentage of the total population. About 1800 the greater part of the farming population still lived in villages; but since then most farms have been moved out to the fields. Thus some villages have a greatly reduced population, while others have become small industrial centres. In the regions where the farming population is densest, 10–40 per cent. of the population get their livelihood through industries, whereas the industrial population in the least fertile regions—apart from the towns—is less than 20 per cent.

M. LE PROF. P. DEFFONTAINES montre la valeur des cartes dressées par le Prof. Vahl, cartes complémentaires, opposant les deux façades du Danemark, la façade occidentale tout rurale et la façade orientale urbaine et industrielle. Il est très intéressant de constater la non-correspondance de la densité de la population et de la fertilité du sol. Les pays fertiles comportent souvent la grande propriété et portent une population moindre. En Danemark la population rurale évolue vers le dispersement, loi assez générale dont nous comprenons difficilement la raison.

THE INTERNATIONAL RELIEF UNION AND A GEOGRAPHICAL ATLAS OF CALAMITIES

GR. UFF. CONTE COMANDANTE G. E. ELIA

See *The International Assistance Union and the Co-operation it will receive from Geographical Science and Geographical Societies* [London, 1928], 15 pp. [Presented to Congress.]

Abstract

Quite recently the League of Nations published in Geneva the Convention of 12 July 1927[1], which after seven years of study, inquiry, and discussion, created the International Relief Union, originally proposed in April 1921, at the tenth International Red Cross conference, for the preparation and co-ordination of assistance to be given in catastrophes due to natural causes. The scheme was evolved by the Italian Senator Giovanni Ciraolo for the purpose of uniting the experience and efforts, both of states and of the great aid organizations, for reciprocal assistance in the event of severe calamities. He claimed that natural scourges knew no economic or political barriers, and that to meet them adequately it was necessary to make careful and thorough preparations soundly based on experience and a careful and scientific study of the geographical factors concerned in the causes and phenomena of such calamities. For this work careful organization is necessary, and it is this that the International Relief Union is destined to supply.

In this connection geographical science is directly interested, since great natural calamities tend to show themselves in geographical regions and are not necessarily restricted to political units. Hence they may be foreseen in area if not in time, because they are always the same in every geographical zone. It is therefore necessary to arrange preventive organization in geographical zones and to produce charts of these zones based on the distribution of all the disasters which have struck or may strike the various continents.

M. LE PROF. P. DEFFONTAINES remercie très vivement le Comte Elia de l'initiative qu'il prend; l'aide que les géographes peuvent apporter à la lutte contre les calamités est très importante. La Société des Nations a besoin de documents scientifiques, atlas des calamités, et établissement des types de calamités.

La géographie humaine représente essentiellement la lutte de l'homme

[1] League of Nations [c. 364 (I). M. 137 (I), 1927, VIII], *International Conference for the Creation of an International Relief Union: Convention and Statute Establishing an International Relief Union*, Geneva, 12 July 1927, 13 pp. (in French and English).

contre la nature. L'un de ses chapitres les plus importants et les plus tragiques est celui de la réduction des calamités.

La Section D du congrès international de géographie adhère au vœu proposé d'apporter la collaboration des sociétés de géographie à l'association internationale contre les calamités.

Elle demande au Comte Elia de prendre l'initiative d'une commission avec le concours de M. Montandon pour mettre au point cette invitation d'aide géographique dans la lutte contre les calamités.

M. ALBERT CHARTON après avoir félicité le Comte Elia du grand intérêt à la fois scientifique et humanitaire que présente sa communication demande sous quelle forme pratique pourra s'instituer la collaboration si désirable entre l'Union Internationale de Secours et l'Union Géographique Internationale.

CONTE ELIA replied that each nation should follow the example of France and appoint a Commission for the Study of Calamities[1]. He suggested that a committee should be formed at once in Cambridge and that the matter should be brought up before a general meeting of the Congress. [See *Resolution*, p. 50.]

DE LA DISTRIBUTION GÉOGRAPHIQUE DES CALAMITÉS ET DE LEUR SUCCESSION DANS LE TEMPS

R. MONTANDON [*Communicated*]

Cet essai sur la distribution géographique des calamités et sur leur succession dans le temps est le résultat d'une étude commencée il y a quelques années et destinée à rechercher s'il existe des "constantes" dans la répartition mondiale des calamités, et si leur succession dans le temps obéit à quelque loi cyclique.

Nous avons procédé, pour notre travail, par étapes successives de 12 mois chacune. Les tableaux ci-dessous résument les statistiques obtenues pour ces trois périodes (1ère période: 1er sept. 1924–31 août 1925; 2ème période: 1er sept. 1925–31 août 1926; 3ème période: 1er sept. 1926–31 août 1927). Pour ce qui concerne le tableau A, nous nous bornons à donner ici les quelques pays qui viennent en tête (celui-ci comprend en effet 114 pays qui ne sauraient prendre place dans ce court résumé). Les calamités retenues ont été les suivantes: tremblements de terre, éruptions volcaniques, glissements de terrain, inondations, cyclones (tornades, typhons, ouragans), sécheresses, raz-de-marée, incendies[2], famines, sauterelles, avalanches.

[1] *Matériaux pour l'Étude des Calamités: Liste et Composition des Commissions d'Étude des Calamités au* 15 *juin* 1928, Genève, Société de Géographie.

[2] Nous ne retenons que les incendies qui détruisent entièrement ou partiellement une agglomération humaine.

Les totaux obtenus pour les trois périodes ont été du même ordre de grandeur, soit: 282, 269 et 258.

Tableau A. *Répartition géographique.*

	1924–5	1925–6	1926–7
États-Unis ...	24	25	25
Italie	19	21	24
Japon	20	19	18
Espagne	16	15	17
Allemagne ...	12	10	15
France	17	11	6
Yougoslavie ...	4	16	9
Russie	6	11	11
Grande-Bretagne	11	6	8
...	...	...	...
...	...	...	...
	282	269	258

Ces statistiques révèlent certaines "constantes" qui appellent les observations suivantes:

(*a*) Ce sont les mêmes pays qui ont été les plus éprouvés pendant les trois périodes envisagées.

(*b*) Le chiffre des tremblements de terre destructeurs est conforme à celui donné naguère par de Montessus de Ballore, soit 31 par an.

(*c*) Les catastrophes causées par les perturbations atmosphériques (cyclones, tornades, typhons, ouragans, inondations) ont atteint un chiffre global presque rigoureusement identique pour les trois périodes, soit:

$$100 + 74 = 174 \text{ pour } 1924\text{–}5.$$
$$98 + 75 = 173 \text{ pour } 1925\text{–}6.$$
$$80 + 92 = 172 \text{ pour } 1926\text{–}7.$$

(*d*) La répartition par continent accuse, elle aussi, des constantes curieuses. Ainsi nous avons pour l'Europe les chiffres suivants: 124 pour 1924–5; 125 pour 1925–6; 123 pour 1926–7.

Tableau B. *Répartition par calamité.*

Tremblements de terre	30	31	31
Éruptions volcaniques	2	3	3
Glissements de terrain et éboulements	6	—	3
Inondations	100	98	79
Cyclones (tornades, typhons, ouragans)	74	75	92
Avalanches	—	2	1
Sécheresses	14	9	9
Raz-de-marée	4	4	—
Incendies	29	19	20
Famines	8	9	10
Sauterelles	15	16	7

Tableau C. *Répartition par continent.*

Afrique	18	17	14
Amérique du Nord	·38	37	36
Amérique centrale	7	11	7
Amérique du Sud	25	13	18
Asie	51	46	47
Europe	124	125	123
Océanie	18	20	13

(*e*) Les chiffres mensuels *maximum* s'établissent comme suit:

Juin (1924–5) ...	33	Juillet (1924–5) ...	35
(1925–6) ...	32	(1925–6) ...	36
(1926–7) ...	34	(1926–7) ...	35

D'une façon générale, les mois d'été furent plus désastreux que les mois d'hiver.

RIVER TRANSPORT IN CZECHOSLOVAKIA

DR K. MALÍK

Abstract

The object of the paper is (1) to mention some most important facts illustrating the economic aspect of water traffic in Czechoslovakia, (2) to devote some consideration to the methods of statistical investigation into water and railway transport in relation to geographical transport problems, particularly to those of Central, East, and South-east Europe, and (3) to give a brief account of the research now being made into the hinterland of the Czechoslovak Danubian ports.

(1) After an account of the characteristic economic-geographical differences prevailing between the Danube and the Elbe river systems and their relation to the hinterland, the national boundaries, and the foreign parts of the two rivers, an attempt is made to show how these characteristic geographical differences manifest themselves in the statistics of the general water traffic. It is shown that the proper significance of the two rivers appears in the transport of goods destined for abroad. The traffic in the Czechoslovak sector of the Elbe is analogous to that of pre-war times. While during the war a temporary decrease set in, after the war a rapid and constant tendency to increase can easily be traced. The traffic has risen to its pre-war level only in imports. The exports on the Elbe show a decrease, due for the most part (*a*) to the constant decrease in the exports of lignite, (*b*) to the cessation of exports of certain important goods coming from the Polish part of pre-war Austria, and (*c*) to a decrease in depth. On the contrary, the Danube shows no such parallel with pre-war times. The

present traffic of the two principal Czechoslovak ports, Bratislava and Komarno, is rising year by year. Komarno, whose traffic amounts to 600,000 tons, was in 1927 the largest river port of Czechoslovakia. This increase seems to be altogether natural and not to be due merely to a temporary boom in business.

There are foreign ports, to and from which traffic is directed, peculiar to each river. With the Elbe almost 80 per cent. of the total traffic is dealt with in Hamburg, while in the case of the Danube the loading and unloading of goods transhipped in Czechoslovakia takes place almost entirely along the foreign part of the river situated to the east of our boundaries. With Brăila and Galatz the water traffic is only small.

Attention is called to some characteristic features of the navigation of both rivers, to the significance of the various ports, to the part played by the two rivers in the total of foreign trade, and to some other interesting facts of secondary importance. [In this connection a number of graphic charts were submitted to illustrate the facts.]

(2) A plea is made for unification of the statistics of railway traffic. As regards navigation which presents many more difficulties it is desirable to have at least a unification of statistics of traffic carried on continuous water systems, particularly of all those respecting the navigation of the Danube.

[A diagram was shown of all places in Czechoslovakia and abroad whence the goods transhipped in Bratislava and Komarno are despatched by whatever means of transport, and of all those to which they are consigned, and of the total quantity and value of the goods loaded or unloaded in these places. The diagram also showed the centre of gravity of the Czechoslovak Danubian traffic.]

M. LE PROF. P. DEFFONTAINES remarque l'extrême importance prise par le trafic fluvial en Tchécoslovaquie malgré la situation du pays sur une ligne de partage des eaux. Les ports du Danube surtout ont crû rapidement et sont devenus de grands ports d'Europe centrale assurant l'écoulement vers les Balkans des charbons polonais. Déjà des compagnies de navigation maritime ont installé des annexes dans les ports d'Europe centrale allant au devant de la marchandise jusqu'en plein continent.

DR JERZY LOTH called attention to the two very different types of traffic at the Czechoslovak Danubian ports of Komarno and Bratislava, the latter showing a considerable export and transit trade and the former rather an import trade. The question had been raised whether this was due to the position of Bratislava at the mouth of the River Morava which might be used to carry the Polish coal that constituted a high percentage of the exports there, while Komarno lay at the mouth of the Váh, a river cut off from Poland by the Tatra Mountains. The speaker explained that this was not the case, the Morava being not yet sufficiently canalized.

DR K. MALÍK replied that the goods including Polish coal which came to Bratislava and Komarno for transhipment were carried by rail, there being no water transport as yet on the Morava and the Váh with the exception of a few rafts on the Váh.

DR V. J. NOVÁK remarked that it had often been said that the Balkanization of Central Europe had irreparably damaged the economic situation. The paper just read showed that the traffic conveyed by water was increasing; and there were other indications that the economic position was improving. This could be made better still if the customs barriers between the Danube states could be made less severe.

DISTRIBUTION OF THE RACES OF FURTHER INDIA

W. A. GRAHAM

Other work: *Siam*, London, 1924, I, pp. 102–77.

Abstract

The Siam Society, of which institution the compiler of this paper is the Delegate to the International Geographical Congress, was established in 1904 for the investigation of matters of scientific, historical, and artistic interest in Siam and neighbouring countries. It is located at Bangkok, practically in the centre of the sub-continent, and in contact with communities of many Indo-Chinese races besides the Siamese; therefore the study of Further Indian ethnography is naturally one of its chief interests, and a good deal of work has been done by it in the investigation of the origins, movements, and developments of the peoples in the midst of whom it finds itself.

The course of these studies has led investigators a good way beyond the confines of Siam and has produced theories concerning races inhabiting not only Further India proper but many of the islands and countries lying to the south, east, and west of the mainland. These theories, it may be said, are by no means unanimously accepted, either in the Siam Society or elsewhere. One such theory concerns the relationship between the inhabitants of the East Indian Archipelago, many of the Pacific islands, New Zealand, and Madagascar, and the races now living on the mainland of Further India; and this paper is an attempt to set forth this theory in accordance with the views of the compiler and some others. The movements of humanity that have resulted in the peopling of Further India are considered, as are the spread of offshoots from the mainland more or less fanwise through the regions surrounding it, and the wanderings to and fro, and back and forth, from which nations, tribes, and clans, as they appear to-

day, have been evolved. The suggestion is offered that Polynesians, Micronesians, Indonesians, Cambodians, and Talaings all come from a common Mongoloid stock with which also the Siamese, owing to their mixed parentage, are in closer affinity than is usually admitted. The theory of the Caucasic origin of the Polynesians and other Far Eastern or Pacific races is discounted.

PROF. A. C. HADDON begged geographers to distinguish between the words *race* and *people*. He urged the importance of the brown, dolichocephalic, short element in the East Indian archipelago. This type is now called *Nesiot* and is an important and ancient element in the islands, in Further India, and in south China. This Nesiot stock has been much influenced by Sub-Mongoloid people; and the combination has migrated into the Pacific, mingling with Papuan negroid elements to form the Melanesians.

21 JULY

CAUSES OF RURAL DEPOPULATION

DR S. VERE PEARSON

See *Abstract* in *Garden Cities and Town Planning*, Jan. 1929, pp. 6–8.

The importance of the two particular factors affecting the distribution of population which I have chosen are, I believe, rather apt to be underestimated by geographers. That is one reason for my choice of them. Another is their influence on the future. Geographers should not only probe into the past which is living in us and study present facts but should also examine the trend of events so as to calculate their effect upon the future and by that means help to guide future events. Prof. Ellsworth Huntington in his latest book *The Human Habitat* (p. 33) has said: "In the long run [though accessibility counts] soil, relief, and especially climate are the main determinants of where people live." That is quite true for the world at large; but most of us are chiefly interested in the distribution of population in the temperate cyclonic regions of the earth, and as geographers, in this Section particularly where we study human geography, we ought to realize that these influences have to-day to take a secondary place. It is economic influences which now largely determine the distribution of population leading people to migrate from rural districts into the cities. The flow to the cities is a phenomenon which has interested people from the days of Nebuchadnezzar and Cicero right down to the present time; but at no epoch has it been so important and so intense as to-day. The causes of this flow are more than ever economic. Climate and methods of food production take secondary place. But

before entering upon the subject of these economic causes I shall refer to the effects of the introduction of the cast-iron pipe which is producing important and increasing results of a geographical nature.

This is the first civilization in the world's history where it has been possible to deliver water under appreciable pressure to the cities. The cast-iron pipe was only introduced about 150 years ago. (It is now being superseded by the lap-welded steel pipe; but that is by the way.) This introduction has affected the distribution of population and indeed it is having effects on physical geography. It has enabled human beings to agglomerate into cities in such a way as no previous civilization has ever known, because without water under pressure in pipes there would be no such things as New York skyscrapers. They would never have been put up, because people could not have lived hygienically—could not have gone on living at all in fact—heaped one above another as in skyscrapers without a water-carriage system of sanitation. It has also had another important influence of a geographical nature; it has interfered with the natural increase of soil-fertility through robbing the soil of her food, animal waste, and excreta. Communities which would have been more agrarian and less industrial—more mixed in fact—would have been more dispersed, and the modern tendency for excessive numbers to participate in the secondary occupations would have been counteracted.

A study of the occupations of plants and animals, of the interdependence of one upon the other, and of conditions of habitat upon numbers, is revealing the ways in which nature regulates the aggregation of populations. Man is able to modify his habitat wilfully to such an extent that evils may occur unless he is careful to learn and to obey natural laws. One of these is that, where animal excreta and dead bodies increase, there plants must be allowed to flourish the more. The country would have invaded the towns, and urban amenities would be more plentiful in rural districts in civilized communities, had not the invention of cast-iron pipes followed by the introduction of a water-carriage system of sanitation made possible the agglomeration of many-storied habitations in cities, and had it not interfered with the natural increase of soil-fertility.

But to return to the actual physical geographical results of the adoption of the water-carriage system of sewage-disposal in civilized countries: look at Chicago, for example; there the Chicago River since the year 1920 has been deepened and widened and the actual flow in it has been reversed. A volume of water more than 10,000 cubic feet per second has been flowing for all these years down that

channel[1]. That is more than 62,000 gallons per second flowing from Lake Michigan into the Mississippi Basin—the reverse of what nature ordained. People in the neighbourhood of the Great Lakes are much perturbed because they find that in the last ten years the level of the lakes has fallen by about $3\frac{1}{2}$ ft. Certain authorities believe that 6 in. of this fall (at all events so far as the Great Lakes other than Lake Superior are concerned) is due to the fact that the drainage system of Chicago is perpetually draining water away. It is true that 2 of the $3\frac{1}{2}$ ft. drop which has occurred during the last ten years is due to the unusual rate of evaporation and the unusually low rainfall during those years. But as to a fall of 6 in. over an enormous surface of water, here is a physical fact which is due to the interference of man in geographical affairs. And the problem does not end to-day. Chicago is growing at the rate of 70,000 persons per year, and it contains factories and stockyards which are estimated as far as water for cleansing is concerned to be equivalent to over a million and a third of people. Hence, although the present flow of water, the 10,000 cubic feet per second which is now flowing to deal with the sewage of Chicago, is sufficient for the present population of Chicago (about three million), there is in addition to that, as it were, another population of over a million represented by the stockyard-waste and the factory-waste which has to be dealt with, as well as Chicago's rapidly increasing population.

Now to come to another physical fact of this nature, but in a different direction: Manchester is drinking up water from another watershed, from the English Lake District, and is building a great dam in connection with Haweswater. In the year 1935 or thereabouts, when the whole scheme will be completed, the Manchester Corporation will be able to take 75 million gallons per day 80 miles away to the Manchester district. The overflow level of Haweswater will then be raised 95 ft. That is another important geographical alteration. The area of Haweswater is to be increased from 346 to 970 acres[2]; so that the English Lake District will, through the hand of man, acquire a lake which is of quite a different character from the lake which nature gave it. In these ways through modern man's insatiable cry for water and ever more water interferences with physical geography are being made; and the President of this Section in his opening address said: "In purely physical geography nine-tenths of the processes investigated are dependent on the physical properties of water."

[1] *The New Statesman*, 12, II, 1927, p. 534.
[2] *Manchester Guardian*, 9, VII, 1928.

In other lands and in other ages, where water is or has been interfered with by man, water is not taken away from one watershed into another entirely different: for example, in the rice-growing areas of China and other parts where irrigation is used.

These acts are interfering with physical geography not only on the surface of the globe but also even below the surface. At a recent conference in Manchester, Mr Edgar Morton[1], who is the Engineering Geologist Professor of that University, read a paper on "The underground distribution and thickness of the secondary formations in England, with special reference to the sources of subterranean water"; and many authorities are considering it advisable that public money should be spent in England to make a contour-map of the underground water-resources. It may seem anomalous for a Doctor of Medicine to hint at any disadvantages which may accrue from modern methods of sanitation which have brought us so many blessings. But I am speaking as a geographer this morning, and in passing I would point out that there are other secondary points connected with this: for example, the pollution of streams. I was referring just now to the Great Lakes; and with regard to these we find that Mr William Gore, in a paper published by the American Water Works Association[2], states that "there are practically no points at which water can be secured free from pollution. In a general way the pollution hugs the shore in the neighbourhood of cities, and there is danger of the pollution of water-works' intakes due to wind-driven currents."

Now to elaborate a little the subject of the decrease of soil-fertility: the Minister of Agriculture of England, in his official publication (vol. XXVI, p. 502), has stated that 18 million pounds worth of nitrogenous manure is cast into the sea each year down our sewers. In this connection, in studying the distribution of rural settlements, it might be worth while to pay a little more attention to the question of soil-fertility artificially kept up by manure and by burial systems. We have had reference to that in some of the papers on this subject at this Congress. For example, Miss Harris in studying the settlements in Alderney has shown the importance of seaweed which has been used as manure in the Channel Islands for generations. But I am sure that in some parts of the world the question of burial systems ought also to be taken into account; and on this point I shall quote a short passage from Prof. Ellsworth Huntington's book, *The Human Habitat* (p. 179): "Having reference to China"—he is writing about

[1] *Manchester Guardian*, 7, VII, 1928.
[2] *Surveyor*, 1926, pp. 69, 389.

a province south of Yangtze—"see how the living encroach upon plots allotted to the dead"—he is referring to their ancestor worship and the disposal of the dead—"leaving first of all spaces 3 ft. by 7 ft. in the midst of a cultivated field, and then only 2 ft. by 5 ft. and then 1 ft. by 3 ft. Finally in some districts the grave is represented by a little pottery cylinder 6 in. in diameter and so small that it merely occupies a space that must anyhow be left between most kinds of plants in order that they may get light and air." He goes on to say: "If all the graves were allowed to remain the full size, most of China would now be a graveyard."

This side of the question is to-day more important than ever because we are told, quite rightly, in geographical circles that discontinuity of good soil is one of the most important factors in accounting for the distribution of population. Yet, thanks to all the researches which have been done by the chemists and horticulturists in intensive culture—some of which were founded by Prince Kropotkin when he was a political prisoner in Paris—we now know that we can make rich soil fairly easily in suitable climates and sites and at suitable altitudes, even if nature did not endow that particular spot with fertile soil. The geographers of Italy might pay particular attention to this point because Italy is a country where the population is increasing at the rate of about half a million a year, and yet by comparison with France the Italians have, it is estimated, only about a quarter of the arable land[1]. That is because so much of Italy is non-fertile or is not fit to be worked arably on account of its being malarially infested or for other reasons. But if the fertile parts of Campania are compared with similar places like Denmark and Belgium, where intensive culture is being carried on, it can be shown that not only fertility of soil but also the system of land-tenure plays an important part in the picture. If the Italians would pay attention to these sides of their agrarian and population problems and of their food-producing possibilities instead of launching out into different elaborate schemes of oversea colonization under the lead of their present Dictator, they would perhaps do more to solve the population question in Italy, and therein they might be helped by geographers.

That leads me to the second half of my paper, the consideration of the economic effects of regimes of property on the dispersal or agglomeration of population. The direct effect which regimes of property have on the distribution of population, as well as the indirect effects through methods of cultivation, have been well brought out in

[1] *The New Statesman*, 29, v, 1926, p. 163.

some of the papers which have been given to us under the head of *Rural Habitat*. Primitive peoples recognized a property-regime which distinguished between the earth, the source of all wealth, and the commodities produced therefrom by human labour. Ownership of the former, bespeaking some form of rent collection (or its equivalent in services) for the common benefit, was vested in the tribe. To-day cultivation for food supplies is far more productive, more scientific, and more intensive than ever before, while radical departures from the regimes of property of primitive peoples have taken root widely. The rent-roll for the common benefit has become replaced by another idea, namely, the property-regime upon which all taxation is based. Tribal action instead of seeing to its rent now-a-days takes products of labour as common property. Agrarian communities fall into a lowly position and decline. In a well-populated country increase in the numbers of rural workers producing intensively is discouraged because tribal action makes access to and tenure of land holdings less instead of more easy and secure, and modern property-regimes do not ensure to each the product he earns. Individuals should be so placed by tribal action as to be able to seek and occupy the habitat individually most congenial. But many are forced by economic causes to agglomerate in secondary industries, while sparsity of population co-exists in agricultural districts leading to less intensive culture and fewer amenities and comforts. Pressure of want and the anticipation of surer employment and of higher wages in towns result from difficulty of access to nature's resources and to the confiscation of taxation. Hence undue specialization and closer habitation in cities occur.

Amongst primitive peoples the origin of private property in land is somewhat complicated, and it varies from one country to another. But we know that it very often primarily depended on cultivation of soil. When pastoral pursuits are left for agriculture, then it seems to become necessary to mark off boundaries to assure the crops going to those who tilled the soil and sowed the seed; particular sites must be held by particular individuals.

Two of the papers in the *Report of the Commission on Types of Rural Settlement* (U.G.I. No. 1, 1928) stand out pre-eminently in bringing out the connection between rural habitat and regimes of property: Miss S. Harris in her paper on "The Village Community of Alderney" (pp. 25–38) and Miss I. F. Grant in her paper on "The Highland Openfield System" (pp. 102–13) show clearly this connection. Prof. O. Marinelli, too, points out (pp. 4–6) that rural habitation

in Italy depends more upon the regime of property system than upon the agrarian system; for he has shown that it varies according to whether the "podere" unit and the "mezzadria" regime or the "contadini" system based on the contract of rent be adopted. I think some of us would appreciate it very much if he would make further investigations along that line. It would also be interesting if Prof. R. Biasutti would correlate the regimes of property and the systems of land-tenure associated with agricultural production in Italy, so as to see whether there is not a distinct connection between such factors and the presence of isolated farms, associations of farms, fragmented villages, or dispersed villages. Yesterday we had an interesting paper from Prof. M. Vahl regarding the density of the farming population in Denmark. He showed that this is by no means everywhere proportional to the fertility of the soil. The population is thinner in rural districts in Denmark where the estates are large, even when this point is studied in those parts of the country where the soil is chiefly boulder clay and the fertility only varies within narrow limits. Denmark, I may mention, is the one country in Europe where the majority of land-*owners* are opposed to the private ownership of land. It is in Denmark that a reversion to natural conditions regarding the regime of property is best seen to-day in Europe. The small-holder is re-colonizing his homeland there with holdings of only moderate extent, while fighting steadily for lower taxes and the collection for the common use of the communal values (land rent). These two tendencies, namely, towards the abolition of taxes and the collection of rent for the public services, are the two essential features for any property-regime which will work smoothly.

The institution of private property in land at the present day is having results widely felt in civilized countries and seriously affecting the future. It has become difficult in modern civilized communities, through the varied complications which have given rise to private property in land, to distinguish between possession and ownership. This is at the root of the difficulties of to-day. Because it became necessary to enclose land to protect crops, or to mark off sites to be held exclusively for other reasons than agriculture, people lost sight of the essential wrongness of private ownership of land; and it did not become obvious how to make exclusive possession secure while continuing to honour public ownership. This is accomplished if it is realized that no injury to others can come about in holding land for exclusive possession provided that the value of such loss of access *to* others be paid them for the common benefit and such share be taken

from others in common services. In other words, land rent must be used for the communal services, thereby placing a man in a fair and proper position to his neighbours for having exclusive possession; just as when, for example, three brothers own a horse, all are quite fairly treated if the use of the horse is given exclusively to that brother who bids the highest for such use, provided that the rent paid for the horse (if it can be called "rent" for a moment) is used for the fodder and insurance of the horse.

I shall now give you a few figures showing how agrarian communities are declining. Take the United States of America: in the last seven years two million people have drifted from farms and agricultural pursuits into the cities, and that represents more than 5 per cent. of the population[1]. In 1920 for the first time in their history the proportion of city to rural dwellers was a little above 50 per cent. (These figures are net figures because there are some people who drift into the cities and others who drift from the cities.) In that connection there is no doubt that difficulty of access to rural land is one of the causes, as is proved by the rise in the value of farm land making access harder. Between 1900 and 1920 the value of agricultural land in the United States of America has gone up three times; in some states in fact, in Iowa for example, the value has gone up five times. Again, if the number of bankruptcies amongst farmers in the United States be studied, it will be found that they number about ten times as many as they did before the War. In England the census of 1921 revealed that 79·3 per cent. of the population of England[2] are not under Rural District Councils, and that the proportion of the people of England and Wales who live in cities of 50,000 or over is 50 per cent. In 1921 62 per cent. of the inhabitants of Australia were dwellers in streets[3], and 46 per cent. of the whole were dwellers in the streets of the six capital cities. Whereas 50 years ago 44 per cent. of Australian breadwinners were working on the land, by 1921 this figure had fallen to 25·8 per cent.

It may be argued that in England there is no difficulty in getting access to rural land; but I do not agree with that opinion. Rural workers are forced by economic reasons into the cities because they are not able to get small plots to work intensively for themselves. Nor can they get decent wages as a consequence of the blocking of such avenues of employing themselves and as a consequence of the

[1] *The Economist*, 5, VI, 1926, p. 1091.

[2] *A Survey of the Social Structure of England and Wales*, A. M. Carr-Saunders and D. Caradog Jones, Oxford Univ. Press, 1927.

[3] *The New Statesman*, 21, I, 1928, p. 455.

hampering effects of taxation. They hope to find employment more obtainable and wages higher in the cities. I can speak from experience on these points, because I have been a keen poultry-farmer and I have had friends in the same line. I know full well that access to small plots suitable for poultry-farms is very difficult to get. A few years ago I was talking to one of the best-known utility poultry-farmers in England, now at the head of the National Poultry-Farm at Bentley near Ipswich. Before he went there, he ran a poultry-farm near Battle, and he told me that it took him a very long time to find a suitable plot for his farm. Several other friends of mine have had the same difficulty. The difficulty of getting small-holdings is great in spite of the Small-Holdings Acts of Parliament which have been passed in the last twenty years. Now if people in thickly populated countries like England cannot produce foodstuffs intensively, then of course more people have to make ships to bring food across the seas, and more people have to busy themselves in the insurance, transport, and freightage of those goods; and most of these congregate in cities. Although we in England must depend very much upon exporting manufactured goods, there is a limit of benefit in that direction. By gaining better access to land, it should be possible to produce very much more in the way of foodstuffs. Many more persons ought to be using their skill in the primary production of home-grown foodstuffs. Again, those who mill flour, instead of being concentrated in a few cities through milling having become largely a series of monopolies from similar causes, should be better dispersed. Then our loaves would not all be made of emasculated flour; and the windmills and watermills of our countryside would not be falling in ruins.

In conclusion, I believe that what I have put second as an influence leading to rural depopulation in several countries ought really to come first, because it is the primary cause. At the root of the maldistribution of population to-day lies the regime of property which so many peoples endure in these times, namely, the firm establishment of private property in land through the private appropriation of community-created land-rent, coupled as this is bound to be coupled with those subtle and manifold forms of State-regulated robbery known by the term taxation.

DR C. B. FAWCETT considered that one of the chief causes of the present-day movement of people into towns was to be found in the mechanization of agriculture. This has reduced very greatly the proportion of the population necessarily engaged in the vital and essentially rural occupation of food-production. It might be estimated that two centuries ago three-quarters of the working population were necessarily agricultural; now that proportion

had fallen to something approximating to one-quarter. Parallel to this was the shifting of other formerly rural industries into towns—*e.g.* cloth-working—as the result of corresponding mechanization of manufacture and transport. These factors had permitted a freer play of the natural tendency in human beings to live near to their fellows, with the result of a concentration in towns.

MISS H. A. HIPPISLEY BARNES said that part of the migration to towns was due to the preference of sons and daughters of labourers for regular hours, fixed wages, and possible pensions to the long and irregular hours and the low or uncertain pay of agricultural labourers and small-holders.

MR E. D. LABORDE observed that rural depopulation was being influenced by the attractions of modern town life. The Bishop of London in the account of his world-tour quoted the evidence of leading Canadians to prove that the youth of Canada did not intend to undertake hard work in agriculture. Prof. E. de Martonne noted in his book *Les Alpes* that the Swiss conscripts having once known the towns did not often return to their villages. In England domestic servants prefer the towns and their cinemas to the dullness of the country.

MISS I. F. GRANT held that depopulation in rural districts was largely caused by the decay of the local spirit. Much of the present depopulation in the Highlands of Scotland was caused by the fact that young men could get a larger reward for their agricultural work in the Dominions overseas. In the Hebrides—especially in the island of Lewis—a very strong local patriotism still persisted; there the people clung to the soil, and the local population was maintained at its highest possible limit.

DR PEARSON replied to Dr Fawcett, who had said that industrial work was best carried on in towns, that he must quarrel with that view, because towns were mostly smoke-laden places where population was concentrated in slums. The garden-city idea was the line to follow. By such methods not only would a better distribution of the population be brought about, but also people would be able to lead a healthier and happier life than that led by most to-day, by combining agricultural with industrial pursuits. In reply to Mr E. D. Laborde he said that the amenities which are possible in rural districts could be greatly multiplied if the population was thicker. In these days of gas, electricity, and wireless, education and recreation facilities could be provided very much more readily than before; but as long as the population was so sparsely scattered in rural districts, it was difficult to provide these amenities amply. In reply to Miss Barnes he maintained that there was only one big objection to the working of long hours, apart from the monotony many had to endure under present-day social conditions, and that was the absence of a just return. If, however, a man could get a just return, viz. the receipt of *all* the products of his labour, then he would not mind working long hours, and working hard. But that was impossible until taxation was abolished, and community-created values alone financed public services, thereby giving equality of opportunity to all.

LOS PROBLEMAS GEOGRÁFICOS EN LA REPÚBLICA ARGENTINA

SEÑOR ALFREDO KÖLLIKER [*Communicated*]

Los estudios de los problemas geográficos en la República Argentina han adquirido en los ultimos decenios una importancia primordial para el desenvolvimiento agricola, comercial é industrial de la nacion. Un pais cuyos limites penetran en el norte dentro de la zona tórrida de los paises ecuatoriales y al sur se extienden hasta los parajes del hielo eterno de la zona antartica; un pais que encierra dentro de sus limites las vastas llanuras de las pampas, inmensos bosques de incalculables riquezas, desiertos bajo cuya capa esteril yacen valores inmensos minerales; que alberga cordilleras; cuyos picos se levantan hasta 7000 metros de altura y que se extienden á lo largo de toda su inmensa frontera Norte-Sud por varios miles de kilometros. Este pais depende para su desenvolvimiento futuro, si quiere figurar entre los primeros paises productores y consumidores de nuestra tierra, del estudio y conocimiento de sus innumerables problemas geográficos. Entendemos bajo problema geográfico todo lo que la ciencia geográfica pueda abarcar. La ciencia geográfica que penetra toda ciencia, que forma parte de todo estudio, que hasta podemos decir es la base sobre la cual arraiga todo estudio cientifico, que tiende á esclarecer las posibilidades que ofrece toda tendencia á allanar los valores de un pais, que pueden ser aprovechados por la raza viviente. Esta *ciencia geográfica*, pues, se impone en esta joven República que hoy es centro de interés de todo hombre del mundo que fija su vista en el adelanto y desenvolvimiento futuro de nuestra tierra. Para concretar se puede decir: La República Argentina ha llegado á su turno y abre sus puertas para contribuir con incalculables recursos al bienestar de la humanidad. En este momento, que realza el corazon de todo argentino, debe secundarnos el intelecto humano, debe acorrer toda ciencia para ayudarnos en este noble esfuerzo. Es pués ante todo la *ciencia geográfica* que debe abrir camino! Es ella que guiará con certeza el esfuerzo humano.

La labor, en lo que se refiere al conocimiento topográfico de la superficie de nuestra patria, no ha terminado aún. Existen sobre tierra argentina vastos parajes completamente desconocidos, yacen valores y riquezas inimaginables, inexplotadas. Aún no terminó la exploracion del territorio argentino. Gran superficie de los montes del Norte de la República permanecen en su estado de "terra incognita." Vastas zonas de la Cordillera Patagonica fueron jamás atravesadas por ser

humano. *El conocimiento de nuestra tierra Argentina es aún incompleta;* yo personalmente he tenido ocasion de tomar parte en la exploracion de nuestra tierra incognita, yo mismo he sentido la necesidad al contemplar esas riquezas desconocidas, de que es indispensable que la geografia argentina reciba un nuevo empuje, que todos y ante todo nuestro Gobierno no omita esfuerzo para abrir estas nuevas tierras al conocimiento del hombre.

Cuantos problemas esperan aún su solucion, cuantos problemas quedan aún poco estudiados; todas nuestras posibilidades industriales y comerciales esperan con ansia el desenvolvimiento de la ciencia geográfica argentina, para multiplicar los frutos, que ya hoy vierten sobre nuestra tierra.

Ahi yacen todos los minerales que pueda ofrecer nuestro globo, yacen hasta hoy prácticamente sin ser explotados. La inmensa pampa argentina, la Mesopotamia y la Patagonia albergarán un dia el múltiple de su riqueza en ganado y campos sembrados, cuando la ciencia geográficohidrologica habrá resuelto el problema del riego.

Una red de rios una vez navegables, abrirá nuevas vias de comunicacion, unirá los centros comerciales con los inagotables depósitos, que forman la riqueza nacional.

Nuestra hulla blanca surtirá con facilidad enormes exigencias de fuerza motriz. Nuestra hulla negra abrirá nuevas fuentes de produccion á la industria y á la elaboracion quimica. Nuestra hulla liquida está destinada á ocupar un primer lugar en el mercado mundial. El conocimiento de los fenómenos de la capa atmosférica que cubre nuestro territorio será de incalculable valor para el desenvolvimiento de un medio de comunicacion que será de suma importancia para nuestro pais—la aereonavegacion.

El mismo conocimiento prestará innumerables puntos de apoyo á la red meteorológica terrestre. La meteorologia argentina, la meteorologia del territorio que une las inmensas superficies del Oceano Pacífico y Atlántico—o mejor, la sola estacion observadora meteorologica sobre medio globo de Oeste á Este!

Y luego, la labor minuciosa del levantamiento topográfico local. Indispensable, aún aparentemente detalle, para el desenvolvimiento de la colonisacion y la labor tranquila del pequeño labrador de tierras; el colono, elemento que afluye de todo rincón de nuestra tierra en busca de hogar y bienestar. Y luego, la geografia de la costa argentina! Vasto problema que abre un nuevo campo de accion á nuestro joven, pero ya próspera industria pesquera y muchos otros problemas más.

El problema geográfico argentino es de actualidad, el estudio de la geografia argentina no solo es una necesidad nacional, sino debe ser considerado por todo hombre interesado, pero ante todo por los hombres al frente de nuestro Gobierno, por los hombres sobre cuyos hombros pesa la responsabilidad por el desenvolvimiento y porvenir de nuestro hermoso pais; como tarea, cuyo desarrollo deben adelantar con todo medio al alcance. No deben temerse sacrificios, pues sin ellos no allanaremos las múltiples dificultades. El problema geográfico argentino no se resuelve con un esfuerzo; el problema geográfico argentino no se vence y jamás desaparecerá. El conocimiento geográfico de un pais es un estudio continuo, es un trabajo que jamás terminará, es una tarea que lleva de adelanto en adelanto, en bien de sus moradores y de nuestra tierra entera. Redoblemos, pues, nuestros esfuerzos, esperemos que nuestro Gobierno apoye en verdadero conocimiento de la importancia primordial del asunto, nuestra tarea! Y ante todo Vds. representantes del mundo entero reunidos ante mi, para colaborar en el desenvolvimiento de la ciencia geográfica, sepan que en la República Argentina yacen problemas de vuestro interés á resolver en bien de nuestro pais, en bien de la humanidad.

Citaré algunas de las *riquezas nacionales argentinas*; todas ellas esperan de la ciencia geográfica ayuda para su desenvolvimiento. Verán Vds. que son múltiples, y que toda ciencia, toda industria y todo comercio hallarán en los valores depositados en tierra argentina un vasto campo de accion, que aportará incalculables beneficios á todos.

La produccion de cereales.

La produccion de ganado.

Plantas industriales. Viñedos, herbales, plantaciones de algodón, quebrachales, etc.

La Caza. Industria de cueros y pieles. La Industria pesquera.

Mineralogia. Todos los minerales, metales, carbon y petroleo.

Estas industrias nacionales con sus industrias anexas abarcan todo lo que produce nuestra tierra y explota el ser humano.

Han oido Vds. señores en pocas palabras, lo que pedimos aún de la ciencia geográfica para nuestro pais. No crean por eso que hasta hoy nada se ha hecho. Una intensa labor fué ya ejecutada! Pero la imensidad de los problemas, lo vasto del territorio, lo múltiple de los intereses nacionales, han puesto en actualidad semejante aglomeracion de tareas urgentes, para decir asi, que es necesario multiplicar los esfuerzos. Hay instituciones que hace años se dedican al estudio geográfico argentino. Hay sabios que dedican toda su inteligencia y todo su tiempo á estudios de esta indole; nuestro Departamento

Militar trabaja incesantemente en el levantamiento topografico del pais. Sabios exploradores de todo el mundo recorren parajes pocos conocidos, con fines de estudios geográficos. La geologia, hidrologia y todos los otros ramos de la ciencia geográfica tienen dignos representantes en nuestro pais.

Pero la tarea es enorme, las soluciones urgen; buscamos ayuda y ante todo la esperamos de parte de nuestro Gobierno.

La Sociedad Argentina de Estudios Geográficos "Gaea" ha encarado con toda energia los problemas fundamentales. Ella ha conseguido reunir un nucleo de hombres de trabajo, sabios, que estan dispuestos á llevar adelante la tarea con todo medio al alcance. Ha iniciado una obra de geografia argentina muy completa, patrocinada por el Ministerio de Justicia é Instruccion Pública. Ha elaborado un programa, tomando en cuenta las necesidades de urgencia. Este programa fué presentado al Ministerio de Justicia é Instruccion Pública y depositado en manos del Señor Ministro Antonio Sagarna. Esperamos que nuestro Gobierno apoye eficazmente la realisacion de estos importantes y magnificos trabajos en bien de nuestro pais.

He aqui el programa detallado: ... Queda pues claramente definida la labor á efectuarse y esperemos que se hallarán los medios á realizarla con la premura que es del caso.

Abstract

Geographical research is becoming of prime importance for the Argentine Republic. National industry and commerce, wheat growing and cattle breeding, depend largely for their development on the results to be obtained by geographical research in the near future. The Argentine territory includes all climatic zones and could be exploited for everything our earth produces and man's work creates. Geographical science has to deal with all these possibilities by inducing men in Argentina to study problems on their true scientific basis.

Industries to be exploited in Argentina. Cattle breeding, wheat growing, industrial plants, hunting products, mineral oils, and many more exist. The Sociedad Argentina de Estudios Geográficos presented two years ago to the Argentine Government a carefully worked out programme, containing all geographical problems of practical and scientific interest for the future development of the Argentine Republic, which was published in the *Anales* of this Society, 1925, No. 4.

The programme[1] contains two different sections, Physiography and Biogeography. It is the object of this paper to draw scientific men's attention to the variety of geographical and associated problems yet to be solved in Argentina, and to express the hope that the Argentine Government will face these problems with energy and give financial and moral help in realizing their solution. Large tracts of Argentine soil are still unexplored. Knowledge of the atmospheric layer of air covering the South American continent will enable aeronavigation to develop great importance in a country whose centres of production are thousands of miles apart and in which other means of communication are rare.

The Minister of Justice and Public Instruction, Dr Sagarna, showed great interest in the programme and promised his department's help. The Military department urges topographical survey of the country. Exploration of little known or unknown Argentine districts is undertaken, men of science explore the flora and fauna of the country, geological research has located enormous riches in oilfields, exploitation of which is proceeding very satisfactorily. Coal has been located in many places; copper, tin, silver, gold, wolfram, and all other metals are found and partially exploited. Millions of tons of natroborocalcite rest under the surface of the Puña de Atacama practically untouched.

It is to be hoped that the enormous task geographical science has to accomplish in our country will meet with the interest it really deserves.

LA SCIENCE GÉOGRAPHIQUE ET LA GÉOGRAPHIE HUMAINE

PROF. B. Ž. MILOJEVIĆ

Il est bien établi que le rôle principal de la science géographique consiste dans la recherche de rapports entre les éléments, matériellement différents, dont se compose une région. Par application du principe de causalité la Géographie a obtenu des résultats très importants, et a acquis son indépendance comme science.

En étudiant géographiquement une région quelconque, on commence presque toujours par envisager le relief, car il est le facteur qui détermine en grande partie les autres propriétés, surtout le climat, l'hydrographie et le monde végétal; en étudiant la nature au point de vue de la Géographie on observe, en général, un ordre presque établi.

[1] Presented to Section D.

Mais quand, après avoir étudié les propriétés naturelles déjà nommées, on passe à l'interprétation géographique de l'économie, des établissements humains, etc., cet ordre—dans lequel les rapports entre les phénomènes étaient représentés comme les rapports entre les causes et leurs effets—devient, en général, moins apparent, disparaît quelquefois, et par divers auteurs est diversement suivi. A cause de cela on peut poser la question: quel phénomène de la Géographie Humaine d'une région est le plus propre pour être lié comme premier aux qualités naturelles de cette région, et qu'on pourrait, en même temps, prendre comme base pour expliquer les autres propriétés de la Géographie Humaine de cette même région?

Il arrive fréquemment que les surfaces économiques, qui sont à proximité d'un établissement humain, ne sont pas suffisantes pour nourrir les habitants. On emploie alors comme champs ou comme pâturages des terres éloignées, par exemple, des plaines alluviales, des hautes régions de montagne, des îlots, etc. Les habitants entretiennent les communications avec ces endroits eloignés, où sont ordinairement les bâtiments destinés à l'exploitation, et les bâtiments pour l'habitation temporaire. Ainsi il existe des régions où, en liaison avec des propriétés naturelles, on ne peut parler que d'un problème de la Géographie Humaine, de l'économie. Sur ces surfaces économiques apparaissent plus tard, très souvent, les habitations permanentes. Mais dans ces cas-là il est clair que la civilisation d'une région commence par l'apparition de l'économie.

Comme dernière propriété naturelle d'une région on étudie en Géographie la végétation, qui est presque une fonction du climat et du sol. Et non seulement dans les latitudes subtropicales et moyennes, mais aussi dans les zones tropicales la végétation a beaucoup changé. A cause de ses besoins économiques, l'homme a modifié la répartition de la végétation, et les plantes utiles ont pris la place de la végétation primitive. Ainsi à l'étude de la végétation, comme dernière caractéristique naturelle d'une région, s'ajoute l'étude de l'économie comme première caractéristique de la civilisation de cette région.

Outre qu'il existe des régions où, de toutes les propriétés de la civilisation, est développée seulement l'économie, et outre qu'on doit, en parlant de la végétation, séparer la végétation spontanée de celle de la civilisation—il reste que la végétation, d'abord par elle-même, ensuite par son influence sur le monde animal, est la base de toute l'économie, fondée sur l'exploitation du monde organique. L'agriculture et l'horticulture ont leurs sources directement dans le monde végétal, l'élevage indirectement. Les différentes formes de la vie

économique d'une région sont ses propriétés de civilisation qu'on peut le plus directement expliquer par la nature de cette région.

Mais la vie économique, déterminée par le monde organique, explique en premier lieu les propriétés les plus hautes de la civilisation d'une région. A cause de différentes conditions naturelles certaines régions doivent avoir différentes propriétés économiques. Presque chaque pays possède une superproduction de certains produits tandis que d'autres, indispensables à ses habitants, lui manquent. Et ce fait provoque l'échange de produits entre les régions et constitue la base de tout le trafic.

Sur les lignes de communication importantes s'établissent les villes, qui ont des rôles importants dans le commerce. Et les diverses formes de la vie économique déterminent les caractères des villages. On sait qu'aux différents modes de la vie—à l'élevage, à l'agriculture, etc.—correspondent des établissements humains qui se distinguent par leur type et leurs bâtiments. Dans les contrées où l'agriculture est développée à coté de l'élevage, les habitations sont localisées presque toujours sur les lignes le long desquelles s'étendent les champs avec les pâturages.

Les régions de vie économique différente ont non seulement différentes sortes d'établissements humains, mais diffèrent aussi par la densité de la population. Il est bien connu que les régions qui ont des qualités économiques différentes se caractérisent par des degrés divers de densité de la population. La différence des taux de la densité est renforcée par le fait que les habitants des pays moins habités, qui ont la vie économique plus faible, viennent dans les pays plus habités, où les conditions économiques sont plus développées et plus compliquées.

Enfin, la vie économique de chaque région est le fondement de son importance générale au point de vue de la civilisation et de la politique.

De tout ce qui vient d'être exposé, on peut conclure qu'il est logique de rapporter les propriétés de civilisation d'une région aux propriétés naturelles de cette région, en parlant, après avoir étudié la nature, de l'économie comme de la première propriété de la civilisation. L'économie, étant l'exploitation du monde végétal et animal, prend sa racine dans les qualités biogéographiques d'un pays. Mais elle est aussi, comme nous l'avons dit plus haut, le fondement de toutes les propriétés de la civilisation, qu'on étudie en Géographie: des communications, des habitations, de la densité de la population, des migrations, de la situation politique et de celle de la civilisation. Si ensuite, comme le fait J. Cvijić, on considère les caractères psycho-

logiques des populations de différentes régions comme appartenant à la science géographique, alors l'économie et les qualités de la civilisation déjà nommées, qui dependent d'elle, sont, sans doute, un facteur important pour la différenciation psychologique. La conséquence de ceci serait de voir apparaître des rapports non seulement entre la nature d'une région et sa civilisation, mais aussi entre cette civilisation et les qualités psychologiques des habitants.

Mais il y a, d'autre part, des sources d'énergie économique qui ne dependent pas tout à fait du monde organique. La houille et la vapeur, les chutes d'eau et l'électricité ont créé, surtout dans l'Europe Occidentale, dans l'Europe Centrale et dans la partie atlantique des États Unis de l'Amérique du Nord, la vie industrielle moderne. Cette sorte d'économie, qui est la plus intense de toutes, a rapidement intensifié les autres propriétés de la civilisation. Ainsi la vie industrielle acquiert une plus grande valeur au point de vue des communications, des établissements humains, de la densité de la population, des migrations, des conditions politiques et sociales. Ici aussi le genre de vie est à la base de la civilisation, mais au lieu d'être la conséquence directe du monde organique, il dépend pour la plus grande partie du monde inorganique. Mais dans l'industrie on donne une grande part à la transformation des matières premières du monde organique de la même région, et, par conséquent, une telle industrie est conditionnée par le monde organique environnant. Il reste encore cette grande industrie où l'on travaille les matières premières d'outre-mer; elle apparaît dans les pays qui ont une situation géographique particulière et une importance politique plus grande, ainsi que dans les pays très habités.

Tous les aspects de la vie économique se caractérisent donc par des conditions particulières au point de vue des communications, des habitations, de la densité de population, etc. Ainsi toutes les particularités de ces propriétés de civilisation ressortent des conditions d'aujourd'hui. Quand on est fixé d'abord sur la situation de la civilisation au point de vue géographique—la situation qui résulte du milieu environnant—alors il faut se demander depuis quand cette situation existe. Mais il arrive plus souvent que la vie économique se développe, et alors ses formes évoluent et se remplacent les unes par les autres. A cause de cela changent aussi les propriétés de la civilisation correspondant aux différentes formes de l'économie. Et par cette transformation les propriétés susnommées sont en partie anéanties, et en partie conservées, adaptées seulement aux nouvelles conditions. Les qualités de la civilisation sont alors plus compliquées et pour les

comprendre il faut connaître la situation économique et sociale antérieure.

M. LE PROF. M. SORRE insiste sur l'intérêt de la communication du Prof. Milojević. Il indique que les idées développées au cours de cette communication se rattachent directement au courant d'idées dont on trouve en France l'origine chez Vidal de la Blache. Les rapports de l'économie industrielle et de l'économie rurale tendent à se compliquer chaque jour. Il y a de cas où la localisation industrielle est à peu près inexplicable par de raisons géographiques. Mais la prise du géographe s'exerce encore sur les effets de l'industrie. Comme remarque de détail il ajoute encore que, si dans beaucoup de cas l'habitation permanente succède à l'habitation temporaire, il en est d'autres où le phénomène inverse se produit.

23 JULY

RURAL SETTLEMENT IN ITALY

PROF. R. BIASUTTI

To be published in a second *Report of the Commission on Types of Rural Settlement, Rapport de la Commission de l'Habitat rural: Union Géographique Internationale*, 193–, No. —.

Other work: *Per lo Studio dell' Abitazione Rurale in Italia: Rivista Geografica Italiana*, 1926, XXXIII, pp. 1–24.

Abstract

Rural settlements in Italy are, in order of complexity: the isolated farm, the association of farms not forming a village, the village fragmented in several small units, and the compact village. But this is not the order of their evolution. The oldest type is certainly the last, the most recent generally the first mentioned. There are probably no traces left in Italy of a primary ancient land occupation with *isolated farms*; these began at very different periods in different parts of the country with a process that is still going on, and, in some parts, is at its very beginning. The "corti" of the Po plains, the "cascine" of the northern Apennines and the "masserie" of the south, where several families live in the same or in connected buildings, are not different in principle from the simple farm inhabited by one family; older than this in the south, younger in the north, they are invariably associated with important pastoral industry.

The *farm-association* and the *fragmented village* are the result of topographical conditions, the first usually dependent on water lines, the second following rugged topography and poor land. This is, therefore, typical of the Alps and of some small districts of the Apennines. It can be added that the truly dispersed village, which appears in parts

of the Alps, is foreign to Italy and can be considered as a secondary introduction.

Farm-groups, fragmented villages, dispersed villages, produce a difficulty in calculating the percentage of the scattered rural population to the whole, because the census has not adopted strictly uniform methods in judging those types of settlements. A map showing the distribution of such percentage can, however, be drawn. It shows that the Alpine fragmented village has been justly taken as concentrated; likewise, but less correctly, some farm-groups of the Po plains. It shows also the enormous prevalence of the *compact centres* in the south and in the islands. Looking for the motives, we can easily see that dispersed population goes chiefly with fertile soil (plains, hills), variety of crops, fragmentation of the land-system (small land-owners, "mezzadri" and "coloni"). Its oldest relics show often fortified houses. Concentrated population seems to follow poorer land (mountain-limestones), large properties, one-type cultivation, and prevalence of hired farm-hands. The village is then completed by temporary abodes, for pastoral uses in the Alps, for cultivation purposes in the south. But all these correspondences are by no means constant, especially in relation to the qualities of the soil; and it remains very often obscure why some districts have kept the old compact village, while others have left or are leaving it. In large parts of Italy the peasants are extremely unwilling to settle out of town, and the colonists have to be called from far away. As a subsidiary explanation, the race-motive can apparently be kept in mind. A comparison between the map of dispersed population and the map of head-form shows certain striking similarities which ought to be taken into account.

MLLE M. FONCIN montre l'intérêt que présente la communication du Prof. R. Biasutti. Non seulement elle apporte une représentation graphique de la distribution de la population dispersée et de la population agglomérée en Italie, mais encore elle soulève des questions d'ordre très général: difficulté pour les géographes d'utiliser les statistiques, multiplicité des causes qui déterminent l'habitat. La comparaison entre la carte de la population dispersée et agglomérée et la carte de la répartition des types ethniques est très suggestive.

M. LE PROF. P. DEFFONTAINES demande ce que les statisticiens italiens entendent par peuplement dispersé et par peuplement groupé, et il s'étonne qu'on puisse se servir de données statistiques pour dresser une carte des types de peuplement. Il constate en outre que la correspondance que le Prof. Biasutti note entre peuplement dispersé et hommes à tête ronde (brachycéphales) se reconnaît aussi dans tout le Sud-Ouest de la France où règne un peuplement surtout dispersé et où dominent des types à tête ronde. Il est curieux de remarquer les rapports entre le Sud-Ouest français et la plaine méridionale du Po et la Toscane. Le peuplement italien se poursuit

facilement dans le Sud-Ouest français à cause des ressemblances de type, de genre de vie, de mode de peuplement, et même de patois.

DR M. A. LEFÈVRE remarque que, lorsque le matériel des cartes topographiques le permet, le géographe qui veut établir la carte de la répartition des types d'habitat doit de préférence se servir de ces données plutôt que de celles fournies par les statistiques. Dans la plupart des cas en effet les cartes donnent une image plus exacte de la manière dont les maisons sont réparties que celle qu'on peut s'en faire par des tableaux statistiques.

PROF. R. BIASUTTI répond (i) au Prof. Deffontaines que la distinction de la population dispersée dans les statistiques italiennes est basée sur la position de l'habitat—isolée ou en groupement très lâche; (ii) à Mlle Lefèvre que les cartes topographiques ne peuvent pas prendre la place des statistiques parce que les bâtiments indiqués sur les cartes ne sont pas toujours de fermes mais tout simplement d'habitations temporaires qui ont une grande diffusion dans des larges régions d'Italie.

HABITAT RURAL DANS LES MAURES

MLLE MYRIEM FONCIN

To be published in a second *Report of the Commission on Types of Rural Settlement, Rapport de la Commission de l'Habitat rural: Union Géographique Internationale*, 193–, No. — .

Résumé

Le massif boisé des Maures, que contournent les grandes voies de communication entre Marseille et Nice, est resté jusqu'en 1890 très isolé et presque uniquement voué à une vie rurale.

L'économie agricole y avait conservé une forme très ancienne. Elle demeurait basée sur la culture du blé, de la vigne, de l'olivier et des arbres fruitiers (cultures intercalaires), l'élevage des moutons et des chèvres, l'exploitation de la forêt, et connaissait encore des procédés rudimentaires (essartage, voire pâture).

Deux types d'habitat rural:

1°. Des *villages*, très agglomérés.

(*a*) villages de hauteur, dans un site défensif, antérieurs peut-être à la conquête romaine (Bornes, Cassin, Ramatuelle, etc.);

(*b*) villages de plaine de date probablement plus récente (Collobrières, le Plan de la Tour);

(*c*) ports (Le Lavandou, St Tropez, Ste Maxime).

2°. Des *fermes isolées*, maisons élémentaires, bâties souvent à plusieurs kilomètres des villages, dans des clairières de défrichement, à une époque de plus grande sécurité et qui existaient déjà toutes au XVIII^e^ siècle.

L'ouverture de la route et du chemin de fer (1890) le long de la

côte transforme et intensifie la vie rurale de la région en permettant l'exportation des produits agricoles (cultures de fleurs et de primeurs, création de vignobles).

Les fermes et les villages trop éloignés du chemin de fer se vident. Maisons en ruines, villages qui descendent. Nouvelle forme d'habitat rural: des habitations dispersées près des nouvelles cultures.

CONTE G. E. ELIA noted the identity of the French Habitat rural with the Italian in corresponding epochs and admired Mlle Foncin for her deep study of the subject. She had shown that France and Italy have had as much the same life in the Mediterranean as if they had been a single nation.

MISS S. HARRIS observed that Mlle Foncin's description of the types of rural settlements in Les Maures suggested that something analogous might be found also west of the Rhône in the region of the Causses.

ENQUÊTE SUR L'HABITAT RURAL EN ÉGYPTE

JEAN LOZACH [*Read by* Prof. A. Cholley]

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Other works: *Enquête sur l'Habitat rural en Égypte: Bulletin de la Société Royale de Géographie d'Égypte*, 1927, XV, pp. 115–24. [*Questionnaire* in French and English.]

Résumé

L'enquête sur l'Habitat Rural entreprise par la Société Royale de Géographie d'Égypte n'a pu être terminée à temps pour le Congrès International de Cambridge, et seuls sont fournis les résultats obtenus pour deux provinces de la Basse Égypte et deux provinces de la Moyenne Égypte.

L'habitat rural en Gharbiya et Beheira (*Basse Égypte*)

Ces provinces se divisent naturellement en deux régions aux limites peu précises, mais qu'on peut approximativement faire passer par El Yahudiya, Hosh 'Isa, Damanhur, El 'Atf (Beheira), Fuwa, Disuq, Kafr El Sheikh, Biyala, Shirbin (Gharbiya). Cette ligne sépare *grosso modo* deux régions où les conditions économiques, sociales et même physiques sont fort différentes, et où l'habitat ne revêt pas les mêmes caractères. Au sud, la terre plus féconde est mouillée à l'excès, et porte une population trop nombreuse, qu'elle nourrit mal. Au nord, le sol souvent humide reste en grande partie infertile et exploité suivant des procédés soit extrêmement primitifs soit, au contraire, tout à fait modernes. En outre si dans les deux provinces pluies et froid ne sont

nulle part en hiver des phénomènes négligeables, ils sont plus fréquents et plus forts dans le nord que dans la partie méridionale.

Cette partie méridionale est restée, malgré l'évolution de la propriété et le progrès des voies de communication, la région des très gros villages, assez rapprochés, nécessairement, mais entre lesquels les groupes isolés d'habitations sont plutôt rares et peu importants, généralement. Ces villages, qui en nombre d'endroits ont une certaine vie urbaine (marchés, abattoirs publics), sont constitués par des maisons étroitement serrées, et construites en grosse majorité de briques crues, la brique cuite tendant pourtant à se répandre malgré son prix élevé. La maison villageoise, aux dimensions des plus réduites, est une ferme "élémentaire" en miniature, elle est à la fois logement de nombreux habitants, abri pour les animaux, dépôt d'instruments, et magasin pour les récoltes, son toit en terrasse sert de grenier, surtout pour le combustible.

Des hameaux, des fermes ou '*ezbas* existent bien en dehors de l'agglomération principale, dans la plupart des villages, et marquent parfois un sérieux progrès dans les modes de construction paysanne; mais ils restent encore peu nombreux, et ne groupent qu'une très faible partie de la population totale.

Le vrai domaine des '*ezbas*, c'est le nord des deux provinces. Là, pendant longtemps, n'ont vécu que quelques bédouins, quelques pêcheurs, ou quelques pauvres fellahs établis sous des tentes, sous des abris de terre consolidée à l'aide de branches de palmier, ou des maisons ou huttes misérables. Mais depuis un demi-siècle environ, des tentatives nombreuses et parfois très heureuses ont été faites pour arracher ces terres à leur stérilité. De grandes sociétés s'y sont installées pour en pratiquer le défrichement; l'emploi de machines modernes donne un caractère industriel à ces entreprises. Industrielle aussi, plus que rurale, est l'apparence des villages ou '*ezbas* qu'on y élève pour abriter les paysans, ouvriers agricoles, locataires ou fermiers. Ces '*ezbas*, construites de brique crue, ou de brique cuite, sont constituées par des séries régulières de maisonnettes toutes identiques, couvertes d'un dôme ou d'un toit incliné en ciment; elles rappellent assez les cités ouvrières de certaines régions européennes de grande industrie. C'est là une forme d'habitat qui répond à un mode temporaire ou simplement local de l'exploitation du sol, et qui vraisemblablement évoluera à mesure que se développera le peuplement de la région.

HABITAT RURAL DANS LA MOYENNE ÉGYPTE

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Résumé

I. Régions naturelles

L'auteur étudie deux régions naturelles: province de Beni Suef et El Faiyum.

La première est une section du ruban de vallée qui va d'Aswan au Caire: simple fossé à fond plat, vert de cultures, entre deux rebords désertiques.

La seconde est une dépression du désert Libyque, reliée au Nil par une gorge étroite; au débouché, le fleuve y a déposé un "delta," un cône d'alluvions; la partie la plus creuse est occupée par un lac résiduel, la Birket Qarun (45 m.).

II. Définitions

A. *Habitat rural, habitat urbain.*

Pour qu'il y ait ville, il faut réunion de plusieurs données:

(1) chiffre élevé d'habitants (10,000 au moins); (2) des maisons cossues, bien construites (pierre, brique cuite); (3) de l'industrie; (4) du commerce; (5) des organes administratifs.

Les bourgades qui ne remplissent pas ces conditions sont: (*a*) des *marchés* ou bourgs ruraux; (*b*) des *villages*; (*c*) des *'ezbas* (c'est-à-dire domaines, hameaux ou petits villages). Le torchis ou la brique crue y domine. Les habitants sont tous des paysans.

Ces 3 catégories d'agglomérations représentent l'habitat rural.

B. *Agglomération, dispersion.*

Il y a *habitat aggloméré*, quand toute la population agricole vit dans des villages en tas, bien séparés, avec intervalles cultivés.

Il y a *dispersion*, quand le peuplement se fait par un semis de hameaux (*'ezbas*).

Il y a *habitat mixte*, quand le village est double: un noyau central, ancien, abritant le gros de la population, et des hameaux satellites, récents.

C. *Répartition des modes d'habitat.*

Habitat aggloméré: bassins d'inondation de la province de Beni Suef (zone de culture ancienne).

Habitat mixte: zone d'irrigation permanente de la province de Beni Suef; "delta" du Faiyum (zone de culture ancienne, mais modernisée).

Habitat dispersé: lisières désertiques du Faiyum et plaine bordière du lac Qarun (terres de conquête récente).

III. Origine des types d'habitat

A. *Habitat aggloméré.*

Ce mode d'habitat régnait sans partage, avant le règne de Muhammad 'Ali—et cela grâce au concours de diverses circonstances:

(1) *l'irrigation des terres* (nécessité de tirer parti en commun de la crue annuelle du Nil, de se prémunir contre ses dangers, de curer les canaux, d'édifier des réservoirs de retenue, des puits);

(2) *l'insécurité politique* (défense contre les pillages des bédouins, contre les vols d'eau des villages voisins);

(3) *l'organisation fiscale* (chaque village jusqu'en 1812–1813 était la propriété d'un fermier qui y levait l'impôt en nature, d'où nécessité d'agglomérer les villageois);

(4) *le régime agraire* (pas de propriété individuelle, mais exploitation en grand, sous la direction du fermier avec assolement biennal).

B. *Habitat dispersé.*

L'habitat dispersé ne remonte guère à plus d'un siècle. Il est dû à plusieurs causes:

(1) établissement de l'*irrigation permanente* (creusement de nouveaux canaux; distribution de l'eau par le gouvernement);

(2) renouveau de la *sécurité* (aucun souci de défense);

(3) naissance de la propriété individuelle et du *capitalisme agraire*.

L' '*ezba* (agglomération d'ouvriers agricoles au service d'un gros propriétaire) représente le type du peuplement dispersé.

C. *Habitat mixte.*

Confiné aujourd'hui dans les zones de colonisation ancienne, mais irriguées en permanence, il tend à devenir le mode essentiel, dominant, du peuplement, car les deux types précédents se dégradent de plus en plus.

RURAL HABITATION IN SHROPSHIRE

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Other work: *Rural Settlement in Shropshire: A Geographical Interpretation: Transactions of the Shropshire Archaeological and Natural History Society*, 4th series, XI, Part 2, 44 pp.

Abstract

Three main types are distinguishable in Shropshire: "Valley," "Hill" and "Forest Townships." There are several sub-types. Shropshire villages are small and mostly formless. The "nucleations" are not comparable to (say) Cotswold villages. Certain definite criteria are used in classification. In the Valley Township a nucleated village is built near the alluvium of an open valley with drift-covered slopes, and in the Hill Township the village is in open upland. The Forest Township contains only scattered dwellings and is (or was) dominated by forests and is poor in alluvium. Consequently there is no marked relationship to topography. North Shropshire is an undulating plain, South Shropshire a hill country. The economy of a township reflects both its "type" and geographical environment.

A. *The Valley Township* is found throughout the Northern Plain (Type 1) and in the Dales of the Southern Hill Country (Type 2). One parish usually contains several dependent townships. Type 1, in shallow fertile valleys, shows a predominance of rich arable land and water-meadow. Expansion took place towards the fertile watersheds; and these dependent *boulder-clay townships*, imperfect reproductions of the mother township, are also rich in arable. In Type 2, arable quickly gives way to hill pasture and expansion has been mainly lateral, dependent townships differing chiefly in the absence of a church.

B. *The Hill Township* is of two kinds, Hill-side and Hill-top. The upper boundary of the *Hill-side Township* is definitely the hill-top, the lower is usually one of convenience. Hill pasture, largely unenclosed, predominates. The village is near the limited arable. In the *Hill-top Township* the village is at the summit. Prees and Wentnor are the only examples. Their position is attributed to the persistence of religious traditions about a hill-top church. The *Peat-moss Villages* are also built on knolls. Both are pastoral.

C. *The Forest Township* is a collection of scattered dwellings each (originally) in its own clearing. The arable is held in severalty, but the forests form common pasture. The type occurs in a solid block east and south of the Clee Hills.

The origin of the hill-, and some valley-, villages was undoubtedly prehistoric. Hill-side villages are the result of downhill expansion of an early community. Further expansion gave rise to more valley villages which in turn developed dependencies. All are recorded in Domesday. Forest townships are probably a comparatively late growth. Squatters' settlements, quite the most recent, occur in all three of the main types.

24 JULY

CLASSIFICATION GÉNÉRALE DES TYPES D'HABITAT

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Other works: *La Densité des Maisons rurales en Belgique: Annales de Géographie*, 1923, 32, pp. 395–417.

Notes on *Agricultural Systems, Western Europe*, 1928: *Report of the Commission on Types of Rural Settlement, Rapport de la Commission de l'Habitat rural: Union Géographique Internationale*, 1928, No. 1, pp. 7–8.

Résumé

Les récentes analyses des types d'habitat sont la plupart restées fidèles à la classification suggérée par Meitzen dans son ouvrage: "Siedelung und Agrarwesen," savoir: la dispersion et l'agglomération; chacun de ces deux groupes pouvant du reste se subdiviser en variétés plus ou moins nombreuses.

L'étude de l'habitat rural en Belgique nous avait convaincu de la nécessité d'admettre trois formes types de la répartition des maisons rurales: dispersion, agglomération, et concentration. Cette classification ayant soulevé des objections, nous en avons repris la vérification, en collaboration avec les élèves géographes du Séminaire de Géographie de Louvain, à l'aide de la carte topographique au 10,000^{e} et au 20,000^{e}, d'observations sur le terrain et en avion. Cette analyse de détail a confirmé pleinement la distinction de trois catégories de types d'habitat: 1^{o}, la dispersion ou l'éparpillement désordonné des maisons; 2^{o}, l'agglomération ou le groupement lâche des habitations, en associations ouvertes, séparées par des champs, des landes, des forêts; 3^{o}, la

concentration, ou le resserrement des maisons en noyaux compacts et généralement très distants les uns des autres. Chacun de ces groupes peut, par certaines formes extérieures ou par un arrangement spécial des maisons, comporter une série de modalités. Ainsi, dans la concentration, les maisons sont tantôt accolées mur à mur, tantôt séparées les unes des autres par un jardin; la dispersion peut être accompagnée d'une agglomération partielle autour de l'église, mais ce noyau central peut aussi ne pas exister; l'agglomération prête plus encore à de nombreuses variétés.

Ces diversités, toutes intérieures, relevant le plus souvent d'influences historiques ou de nécessités du milieu, n'oblitèrent cependant pas l'aspect caractéristique qui s'attache à chacun des trois types d'habitat qui viennent d'être définis et que nous mettrons en évidence par le commentaire d'échantillons de la carte belge au 10,000^e et au 20,000^e.

RURAL HABITATION IN WESTERN FRANCE AND THE CHANNEL ISLANDS

MISS S. HARRIS

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Other works: *The Village Community of Alderney: Sociological Review*, Oct. 1926, pp. 265–78; and *La Communauté de Village d'Aurigny* (traduit par A. Demangeon): *Annales de Géographie*, 1926, 35, pp. 293–7.

Some Notes on Field Systems in Mediterranean Lands and in the Atlantic Coastal Lands of South West Europe: Sociological Review, July 1928, pp. 197–212.

All the above reprinted in *Report of the Commission on Types of Rural Settlement, Rapport de la Commission de l'Habitat rural: Union Géographique Internationale*, 1928, No. 1, pp. 25–38, 20–24, 81–96.

Abstract

I. *N.W. Europe*

Meitzen classified settlements in N.W. Europe into two types: (1) Germanic, with intermingled strips in "open fields" and nucleated settlements or "Dörfer," based on communal organization and with a three-field rotation. (2) Celtic, with individual holdings gathered round scattered homesteads or "Einzelhöfe," involving no communal cultivation. He shows N.W. Europe as a region of "Einzelhöfe," and claims that incoming Germanic tribes introduced type (1) into W. Europe. Recent research shows that there are some essentially

"Germanic" features in Meitzen's "Einzelhof" region, but it is difficult to say whether they are "native" or "introduced."

II. *The Channel Islands*

(1) Alderney [summarized from *Report*, *U.G.I.* No. 1]. This island has the nucleated settlement of St Annes with "open fields" around it and common pastures beyond them. Written documents prove that householders had right of common grazing on the stubble and that there was a one-field rotation.

The *Report* emphasized the contrast between Alderney and the other Channel Islands, but later research has shown that Guernsey and Jersey also had "open fields"; this is important, because Meitzen quotes Jersey as a typical example of "Einzelhof" region.

(2) Guernsey. Open fields are shown on an eighteenth-century map. The settlements are groups on fertile patches (*a*) on the plateau near the sources of streams, or (*b*) by the coast near springs. Nucleation is most marked round the parish churches, which are on sites of prehistoric sanctity. Documentary evidence shows that householders had right of banon and of common pasture.

(3) Jersey. The physical control of settlements and the association with prehistoric monuments are similar to those in Guernsey. The island also had open fields. Written records state that the island was unenclosed and subject to banon.

The system of both Guernsey and Jersey was probably one-field.

III. *Brittany—The Islands*

They differ from the Channel Islands in having "fallow." This does not involve a change in organization but in the scheme of rotation—the one-field becomes two-field, with its variants four-field and six-field.

(1) Houat [summarized from *Report*] has nucleated village with communal organization and a four-field rotation.

(2) Hœdic [summarized from *Report*] has the same features as Houat.

IV. *Brittany—The Mainland*

St Germain, in the Carnac region, is a nucleated settlement of coastal type common in Le Morbihan. The group consisted of four households possessing communal organization. There was a large proportion of arable fringed round with meadow or heath. The holdings were in intermingled strips. There were four fields, and an additional two fields.

Conclusion

The Ægean two-field system [described in *Report*] may have come west with coastal trade; or settled groups finding their corn-patch exhausted may have used fallow and evolved a two-field system. Either solution seems preferable to the idea of the introduction of field systems by Germanic invaders. In any case the presence of the "Dorf" in Meitzen's "Einzelhof" region has to be accounted for.

RURAL HABITATION IN THE UPPER DERWENT BASIN, YORKSHIRE

MISS E. HALLIWELL

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Abstract

The distribution and types of settlement of the upper Derwent basin in Yorkshire correspond remarkably with the distinct east–west zones into which the region is divisible physically.

A. The best developed line of villages, round the margins of the Vale of Pickering, can be correlated with the presence there of a superb line of springs, a broad band of fertile, arable, well-drained soils, and an advantageous position between the agricultural lowland and the wooded and pasturable uplands of the tabular hills. These villages are of considerable size and are all nucleated; chiefly they are T- or +-shaped, though three are built round a green. Their whole system of economy closely corresponds with Mr Peake's "valley village," with the long, narrow townships stretching from the Derwent up to the watershed of the North York Moors. Such are Pickering, Ebberston, Helmsley and Kirkby Moorside.

B. The second group includes the villages perched on the higher southern slopes, or in some cases the summits, of the tabulars—possibly established as early fortified sites (as Cropton)—where the basis of existence is inadequate for the support of a large community, so that these villages are smaller than the A group. The most typical village form is a single wide street, the houses being built regularly on either side. Distinct evidences of a field-system (probably three-field) are seen in many: *e.g.* Newton and Appleton.

C. North of these lies a set of villages in the east–west valleys at the foot of the tabular scarp, probably of later origin than those to the

south (except, perhaps, Lastingham). Hutton-le-Hole is the only one with traces of a three-field system.

D. The most northerly zone constitutes that of the upper reaches of the north–south moorland dales, in which the nucleus of a village is almost entirely lacking and settlements assume the form of isolated farms with consolidated holdings, and where stock-farming is of greatest importance.

This classification into zones does not hold good in the actual area of the Vale of Pickering, where the broadest generalization that can be made is that practically all the settlements are confined to the isolated hillocks in the west. They resemble hamlets rather than villages.

The series of invasions (chiefly Norse) to which the area has been subject are distinctly traceable in the dialect and population, in both of which the Danish type seems originally to have predominated; the place-names are, however, chiefly of Saxon origin.

INDUSTRIALISM AND SETTLEMENT IN WESTERN CANADA

H. A. INNIS

The papers which have been read before this Section and those published in the *Report of the Commission on Types of Rural Settlement* 1928 have dealt chiefly with settlements in England and in Europe which had been thoroughly established at the beginning of the so-called Industrial Revolution. These settlements have been profoundly influenced by modern industrialism, but in most cases a continuity of life and organization is evident. This paper purposes dealing with a radically different type of settlement—such as is found especially in Western Canada and the new countries—which have had their *raison d'être* in modern industrialism. Although a study of these settlements must proceed from different premises, it is hoped that the final conclusions may prove suggestive to the study of the types of rural settlement which have been of chief interest to this Section. Moreover, a study of the influence of modern industrialism as confined to Western Canada should be of value to the study of settlements in new countries such as Argentina and Australia. This paper can only attempt a study of the background of the main movements and clear the ground for later more intensive work. It must be content

with a survey of the factors peculiar to the spread of industrialism as they are shown in Western Canada.

In the first place an appreciation of the characteristics of modern industrialism is essential. The general trends are well known as to space and time. The conspicuous rise of industrialism in the latter half of the eighteenth century and in the nineteenth century in England, and the spread in the latter half of the nineteenth century, especially to the United States, Germany, and Japan, are matters of common observation. The spread has been of an uneven character and has been affected materially by wars and in turn by the development of the iron and steel industry. The United States became rapidly industrialized after the Civil War, Germany after the Franco-Prussian War, Japan after the Russo-Japanese War. The repercussions of the Great War on the industrial growth of the new countries have been evident on all sides. Important as these sudden spurts of industrialism have been to the new countries, they must not be permitted to obscure the significance of steady and persistent experimentation essential to the evolution in technique of machine industry. The technique involved in the countries which have had the longest experience, as in England, has been modified and improved and borrowed wholesale by the new countries[1]. The painful experiences incidental to earlier inventions have been eliminated and the results of the experiments are taken over with little difficulty by the new countries. Industrialization of the new countries, given suitable political and social organizations, tends to become cumulative—the United States became industrialized more rapidly than Great Britain and Canada more rapidly than the United States. The more recently the country has been industrialized, the more rapid tends to become its industrialization.

On the other hand, the cumulative tendency is accompanied by a continuity. The early centres of industrial growth become more directly linked with the new centres. The experience, fixed capital, financial and social organization, and the advantages which facilitated the growth of industrialism are factors which enable the older centres to benefit from the industrial growth of the new centres. Abundant supplies of iron and coal and accessible, all the year round, water-

[1] See Thorstein Veblen, *Imperial Germany and the Industrial Revolution* (New York, 1918) for the argument on Germany's borrowing, and numerous references in C. R. Fay, *Great Britain from Adam Smith to the Present Time: an Economic and Social Survey* (London, 1928) to the borrowing of the United States. The problems of anthropology which centre about the study of diffusion of culture as shown in C. Wissler, *The Relation of Nature to Man in Aboriginal America* (New York, 1926) and W. F. Ogburn, *Social Change* (London, 1923) are of crucial importance to an understanding of settlement in Western Canada.

transport permit continuous operation, the reduction of overhead costs, and the concentration of industry. The advantages of England as an industrial centre need no description.

The significance of the cumulative tendency of industrialism and of the continuity of industrialism to Canada and the new countries is obvious. Canada has been able to produce on an increasingly large scale, on account of the essential advantages of machine industry, the raw materials for the industrialized countries. She has in turn provided a market for the products of the industrial countries. Her limitations, of iron and coal, and of her seasonal navigation, have made her more dependent on the older industrial countries. The concentration on raw materials is immediately suggested by a reference to wheat, lumber, pulp and paper, minerals, and fish. The rapidity with which production in these commodities has increased since the opening of the present century has depended on extensive borrowing of technique from the United States which had been earlier engaged in providing these staples to Great Britain and Europe. It has depended also on the increasingly rapid industrialization of the older countries with the rapid growth of urban population and the increasing demand for supplies of raw material especially with the exhaustion of old sources.

From the standpoint of this paper we can limit our attention to the study of wheat[1] as produced in Western Canada. The Civil War in the United States gave a direct impetus to the iron and steel industry and rapidly hastened the spread of industrialism. In the succeeding decade railroad construction proceeded rapidly and the wheat-producing areas were rapidly extended. In the new areas the technique of production was improved materially, especially in the decade from 1872 to 1882. Immediately after the Civil War the self-rake reaper was in general use. The harvester displaced the self-rake reaper between 1872 and 1875, and the wire binder came in between 1874 and 1878, to be quickly displaced by the twine binder in 1879. The effect of these improvements was shown in a reduction of the number of men required in the peak harvesting season, the saving of grain and the rapid occupation of the north-western states. The self-rake reaper required for 1 day, cutting 11 acres, 2 horses and a driver, 4 or 5 men to bind and 1 man to shock. The harvester required 2 men to bind and 1 man to drive 2 horses. The twine binder with a 6-ft. cut required for 12 acres a day 3 horses and 1 man to drive and 1 or

[1] See T. B. Veblen, *Price of Wheat since* 1867, *Journal of Political Economy*, I, p. 68.

2 men to shock. With the introduction of steam-power and especially of the straw-burning engine in 1875 to 1880, harvesting was speeded up materially. With these technical advances, the Homestead Act of 1862 and the uniform system of surveying of quarter-sections of 160 acres and townships of 6 square miles, the territory was rapidly settled and brought under cultivation. Transport improvements accompanied the improvements of agricultural implements. Steel rails were substituted for iron, canals were enlarged, and larger grain vessels introduced on the Great Lakes, especially from Chicago to Buffalo. Rail competition forced down lake and canal charges; and reduced costs of handling at terminal points, as Chicago, New York, and Liverpool, accompanied lower freight rates. Grain elevators were in use in Liverpool towards the end of the decade and were rapidly installed in other centres. Improved marketing accompanied improved transport. After 1874 grain was graded and shipped in bulk, whereas formerly it had been handled chiefly in special lots on consignment. Through these reduced charges it was estimated that the cost of hauling one bushel of wheat from Chicago to New York declined from 1876 to 1881 from $32\frac{1}{4}$ cents to $17\frac{4}{10}$ cents. Ocean shipping was subject to marked improvement. In 1867–8 the iron steamship was beginning to replace the sailing vessel. Ocean freight rates declined steadily from 1873 to 1891. Indirectly improved ocean-transport favoured the position of hard spring wheat. Fresh meat shipments to Great Britain began about 1875, and the winter wheat sections became more concerned with mixed farming. Hard spring wheat occupied a stronger position, however, through the introduction of new milling processes after 1880–1—the roller process and the gradual reduction method. After 1875 winter wheat tended to remain stationary and spring wheat to increase rapidly. The higher price of winter wheat gradually disappeared and by 1889 had vanished entirely.

In the decade from 1872 to 1882 wheat production had increased materially in the United States. England as a consuming country through increasing industrialization became adjusted to this situation. It has been shown that from 1852 to 1872 the price of wheat in England varied inversely with British crops. After 1872 the world crop became a determining factor, and price became the relation between the crop of industrial countries and the world market. The American price of wheat was governed neither by the American volume of wheat nor by the British volume. Wheat had shifted to a world market, and England became more definitely dependent on outside areas for her food supply.

The technical developments in the United States responsible for a rapid increase in the production of wheat and the increasing industrialization of Great Britain were significant factors in the opening up of Western Canada. The experience of the United States was taken over and adapted to Canadian territory. In railroad construction Van Horne, Shaughnessy, and others brought to Canada the ripe experience of the United States. Lower costs of production for dynamite facilitated construction through the difficult Pre-Cambrian area north of Lake Superior. Railroad cars, rails, and general equipment were produced at lower costs through the advantages of American experience and large-scale production. The Canadian Pacific Railway[1] was completed from Winnipeg to Vancouver on the West and to Montreal in the East in a remarkably short period of time—almost one-half of the time provided for in the charter. The country was rapidly surveyed and the territory opened for new settlers, who were brought into the country by extensive advertising on the part of the railway and the government. The industrial equipment of the United States, of Great Britain, and latterly of Canada hastened the production of agricultural implements, of lumber for farm buildings, of fuel, and of food and clothing. In the wave of industrialism of the past century and a half, Canada was in the crest and received the full impetus of the momentum.

The geographical background tended to accentuate the rapid development of industrialism and the rapid borrowing from the United States. In the first place the continental background of the United States was an important factor in the development of large-scale production, mass output, and low costs. The level prairies of Western Canada facilitated rapid railway construction[2] and rapid occupation by settlers. The relative absence of large trees made possible the rapid breaking up of virgin soil and hastened the production of wheat. The Great Lakes offered a convenient waterway for the shipment of great quantities of wheat to the Atlantic seaboard. Geographical handicaps[3] occasioned by the location of the mountain-passes which determined the projection of the main line were of relatively slight importance.

The political background had a similar tendency to accentuate rapid development. The prairie provinces and British Columbia were

[1] See H. A. Innis, *History of the Canadian Pacific Railway* (London, 1923), *passim.*

[2] See W. H. Barneby, *Life and Labour in the Far Far West* (London, 1884) in which six and a half miles is given as a record for one day's construction.

[3] The Kicking Horse Pass necessitated the development of less productive soil in the south.

transferred at practically one stroke from the control of the large centralized organization of the Hudson's Bay Company[1] to the government of Canada. It was imperative that Western Canada should be developed in the shortest possible time from the standpoint of the prosperity of Eastern Canada and from the fear of annexation to the United States. The importance of the unified control of Eastern Canada was shown in the substantial subsidies in money, in land, and in other forms to hasten the construction of the Canadian Pacific Railway and the settlement of the west.

The political background affected in turn the financial background and hastened the spread of industrialism. Control of the railway was placed in the hands of a single company in order that construction should be carried out more rapidly and that the country should be settled more effectively. The energies responsible for rapid settlement could be directed with great effectiveness toward the single task of encouraging immigration and developing traffic. Moreover, the impact of the tremendous overhead charges involved in railway construction especially through the Pre-Cambrian area in the east and the Rocky Mountains in the west, and in the heavy peakload traffic incidental to the export of wheat in the season of open navigation necessitated the immediate and rapid settlement of the west.

Another important factor in hastening the spread of industrialism in Western Canada was the growing efficiency of the price-mechanism. Wheat produced in Canada was sold on a world market in return for a direct cash payment. The numerous transactions involved in the transfer of wheat from the Canadian producer to the English consumer necessitated a high stage of efficiency in the marketing of wheat and in foreign exchange and internal exchange. Canadian banks[2] were rapidly extended from headquarters in the east, and adjustments were made by which wheat could be sent directly from the frontier to the centres of industrialism with the least possible friction. This efficiency assumed improvements of communication, elaboration of banking skill, and a comparatively effective educational system.

The cumulative effects of these factors were shown in the marked and rapid increase in the production and export of wheat[3]. The effects

[1] I have tried to show elsewhere in a history of the fur trade the importance of the centralized organization to Canada.

[2] See Victor Ross, *A History of the Canadian Bank of Commerce* (Toronto, 1920), especially vol. II.

[3] For statistical evidence the *Canada Year Book* should be consulted. The increase was far beyond the most optimistic estimate of those consulted in James Mavor's *Report to the Board of Trade on the North-west of Canada* (London, 1904).

on settlement of this concentration on wheat production may be suggested. Settlers were scattered along the railway lines in a belt generally not exceeding 20 miles[1] on each side of the right of way or of a total width of 40 miles. Land was occupied which could be broken into cultivation with the least possible difficulty and from which grain could be hauled to the elevators for shipment with the lowest possible costs. Land areas near the railways not suitable to wheat production have been devoted to other products, with the aid of the railway companies, for example in financing irrigation projects. Rapid production of wheat involved the immigration of virile young men. Farm buildings were rapidly constructed on the quarter-sections with reference to accessibility to field work. Family life and social life were temporarily broken up. Wheat production involved periods of great activity in the sowing and harvesting and periods of relative inactivity in the winter months and the growing seasons. Long-run fluctuations followed periods of prosperity and depression, depending on prices but chiefly on the weather and on seasonal changes of a long-run character. As a result of these factors, social and community life was seriously handicapped. Village communities transplanted especially from Russia, as with the Dukhobors and the Mennonites, faced obvious difficulties. Schools, churches, and the centres of community life generally grew up very slowly. Urban centres were created in direct relation to the railroads and the convenience of elevators for grain shipment, *e.g.* approximately 8 miles apart with loading platforms 4 miles. These centres became distributing points for supplies, *e.g.* agricultural implements, lumber, coal, and general merchandise. Larger centres flourished at divisional points located approximately 110 to 130 miles apart, depending on accessibility of water and the efficiency of engines, at which engines and train crews were changed. The largest centres were dependent on the location of branch lines and junction points, of terminal points, and the stimulus to population afforded by government buildings[2], educational facilities, and wholesale houses. The importance of railroads and government subsidies to the growth of towns has been largely responsible for periods of feverish real-estate speculation and the heavy charges for long street-car lines, electric light lines, gas pipes, telephone lines, and sewerage systems characteristic of the urban centres of Western Canada.

[1] Wheat may be hauled 50 miles to the elevators, but the handicaps are obvious.

[2] In Saskatchewan the University is located at Saskatoon, the parliament buildings, the normal school and police headquarters at Regina, the provincial asylum at Weyburn, and the penitentiary at Prince Albert.

With increasing population industrialism has been partly responsible for an alleviation of the difficulties of slow community growth. Branch lines have been built giving greater accessibility. The automobile, the telephone, and the radio have contributed to a solution of the problems. Better living conditions have followed the improvements of transport and communication. The wheat pool has developed as an evidence of a new solidarity.

It is not the intention of this paper to discuss in detail the effects of industrialism. It is hoped rather that an appreciation may be gained of the necessity of a different point of view for the study of settlement in new areas. Important as has been the work of Prof. Gras[1] and his students in the study of metropolitan economy, it is doubtful whether the conclusions can be applied satisfactorily to Western Canada. Certainly settlement in Western Canada differs fundamentally from settlement in Eastern Canada and in the old world.

THE DISTRIBUTION OF URBAN SETTLEMENTS IN THE NORTH CENTRAL UNITED STATES

DR WALENTY WINID [*Read by* Dr Jerzy Loth]

In accordance with European practice urbanization in the United States is represented by the percentage of urban population as compared with the total number of people residing in a given territory or in the country at large. The Census Bureau classifies as urban population that residing in cities and other "incorporated places" having 2500 inhabitants or more[2]. Now on even superficial observation it becomes apparent that many "incorporated places" with even a smaller number of inhabitants than the Census Bureau's minimum constitute in reality urban settlements—if by an urban settlement we mean one which, in its external form, stands out in the country's landscape as something distinct from its surroundings forming a special group of buildings, principally homes, and whose internal structure manifests arrangements facilitating community life such as streets, sidewalks, street-lighting, water supply, fire protection, proper sewage-disposal, provisions for order and safety, and whose residents

[1] N. B. Gras, *An Introduction to Economic History* (London, 1922), also M. Hartsough, *The Twin Cities as a Metropolitan Market* (Minneapolis, 1925).

[2] *Fourteenth Census of the United States taken in the year* 1920, vol. I, *Population*, 1920, Dept. of Commerce.

derive their livelihood from occupations other than agriculture only. To be sure, the greater the number of inhabitants, the more pronounced are the urban characteristics. But the writer's study has brought to light the fact that even settlements having a population of less than 200 are of an urban type. Thus he has made the discovery, which, in fact, is in accord with the nature of things, that the smaller the general number of incorporated places is in a given region, the more significant become these small places as centres of urban life, the interests of the inhabitants being absolutely "centripetal" in contrast to life in the "open-country," the tendency of which is "centrifugal[1]." The landscape of the "open-country" is all the more striking, since in contrast to the prevailing European custom, *e.g.* in Poland or in Germany, its population lives scattered over the country in homesteads which stand by themselves apart from those of others.

The number of settlements under 200 inhabitants given in the first table is comparatively small, reaching in exceptional cases 20 per cent. of all incorporated places, and in only one case 22·5 per cent. (N. Dak.). Of these, settlements with a population of less than 100 are still fewer comparatively. In nine of thirteen states studied, settlements of less than 100 make up about 1 per cent., in two about 2 per cent., and in two 4 per cent. Places of 500 and more inhabitants fall into two classes: 60·1–67 per cent. in five states, 42·5–48 per cent. in six states. Kansas and North Dakota constitute exceptions, the former with 52·6 per cent., the latter with 34 per cent. Places of 2500 and over may be grouped into similar classes, but, of course, with lower percentages: namely, five states having 15·3–21 per cent. of such settlements, five 5·1–8·9 per cent., North Dakota 4 per cent., Kansas 11·9 per cent., and Kentucky 13 per cent.

If, then, we were to regard as urban only incorporated places of 2500 and over, the urban settlements would be very sparse (see Table II). But because we are studying the question geographically, with a view to determining the distribution of such settlements as by their grouping of buildings, chiefly homes, become distinguished and separated from their surroundings, we must take into consideration incorporated places of an even smaller population. Moreover, for general reasons and for special as well, peculiar to the United States, the smaller settlements are also "towns," *i.e.* centres of trade and community life.

[1] See Dr Hugo Hassinger, *Über Aufgaben der Städtekunde, Petermanns Mitt.*, 1910, 56, II, p. 292.

Table I. *Incorporated Places.*

		Number			Percentage		
	Total	below 100 inhab.	10,000–25,000 inhab.	above 25,000 inhab.	below 200 inhab.	500–2500 inhab.	above 2500 inhab.
Michigan ...	447	3	14	14	4·0	46·0	21·0
Wisconsin ...	456	1	12	9	4·0	49·0	18·0
Ohio ...	874	7	29	21	8·6	43·5	18·0
Indiana ...	486	6	19	12	7·0	48·0	19·0
Illinois ...	1111	13	27	17	7·6	45·3	15·3
Kentucky ...	390	12	4	4	20·5	34·9	13·0
Minnesota ...	689	15	8	3	16·3	36·2	8·6
Iowa ...	908	21	11	7	16·8	38·8	8·9
Missouri ...	714	34	8	3	17·4	36·4	8·8
North Dakota	288	12	3	—	22·5	30·0	4·1
South Dakota	273	3	1	1	16·5	41·6	5·1
Nebraska ...	512	8	3	2	16·0	36·5	6·0
Kansas ...	523	2	14	3	6·0	40·7	11·9

Based on data taken from *Fourteenth Census*.

The territory here studied spreads among prairies, stretching from the Appalachian highlands to the eastern highlands of the Rocky Mountains and from the Canadian border to 37° 30′ N. lat. Eastern Ohio and especially Kentucky enter into the Appalachian region, and South Dakota in a similar way into the Rocky Mountains, whose promontory known as Black Hills extends into western South Dakota. The northern tract in respect of land characteristics and general contour extends into Canada, and the southern into the region of the "cotton" or "black belt," particularly Missouri, whose southern part reaches to the Ozarks. Iowa is a typical farming state of the "corn belt," while Ohio constitutes a transitional country from the industrial and mining east to the agricultural centre, which in its western extreme becomes a part of the "wild west." Kentucky is rather a peculiar country in respect both of its physical character and the customs and manners of its inhabitants. In general, the entire territory here under discussion in respect of its characteristic formation and landscape approaches very closely to Poland and Germany, and along its borders forms a contrast to neighbouring landscapes which differ distinctly from it.

The discussed territory may be divided into several parts: (A) eastward from the Mississippi, (C) westward from the Missouri, and (B) the region lying between these two rivers. Other divisions are the belts: (*a*) Northern, (*c*) Southern, and (*b*) Central.

Table II. *Incorporated Places.* (*Average numbers.*)

			Population			Distances in miles between places		
			general per sq. mile	total	above 2500 inhab.	total	above 500 inhab.	above 2500 inhab.
(A)	(*a*)	Michigan ...	64	69	61	11·5	13·8	24·8
	(*a*)	Wisconsin ...	48	58	47	11·1	13·5	26·0
	(*b*)	Ohio ...	141	72	64	7·0	9·0	16·6
	(*b*)	Indiana ...	81	61	51	8·6	11·0	20·0
	(*b*)	Illinois ...	116	78	68	7·1	9·1	18·0
	(*c*)	Kentucky ...	66	34	26	10·1	14·7	28·0
(B)	(*a*)	Minnesota ...	29	59	44	10·8	16·4	37·0
	(*b*)	Iowa ...	43	56	36	8·0	11·5	26·2
	(*c*)	Missouri ...	49	58	47	10·0	14·6	33·0
(C)	(*a*)	North Dakota	9	33	14	15·6	26·8	76·6
	(*a*)	South Dakota	8	39	16	16·8	24·5	74·3
	(*b*)	Nebraska ...	17	53	31	12·2	18·8	50·0
	(*c*)	Kansas ...	22	51	35	12·5	17·6	36·6

Based on data taken from *Fourteenth Census*.

The foregoing table shows the increase in urban settlements towards belt (*b*), (C) excepted in places of 500 and over. Eastward the increase is irregular and notably different. The average distances in miles in the county belt lying along the 40° N. lat. vary in numbers as shown below:

	Ohio	Ind.	Ill.	Mo.	Kans.–Nebr.
Total	4·9– 9·7	5·1– 8·0	5·6– 8·6	7·2–12·7	7·7–22·0
500 and upwards	7·3–11·6	6·5–10·3	8·6–16·0	9·1–20·7	12·6–38·5

While along the western border of this territory the distances vary between 16·2 and 27·3, or 26 and 49·8 miles, they vary along the 97° W. long. 8·4–12·3, or 14–18·5, on the border of Illinois and Indiana 6·8–9·2, or 9·7–10·4, Indiana and Ohio 6·3–7·8, or 9·4–10·2, and in eastern Ohio 7·2 or 8·4. Most urbanized is Ohio, then Illinois, and least the Dakotas. In (*a*) the number of settlements of 2500 and upwards increases eastward, while those of 500 and upwards have the maximum in Wisconsin and "total" in Minnesota. The northern belt is more urbanized than the southern in (A) only; but Kentucky has comparatively more incorporated places. In (B) Missouri leads Minnesota, and in (C) Kansas outdistances all other states. There, too, the further north they are situated, the sparser are the places of 500 and over; but, taking the general total into account, their greatest number is in Nebraska, their smallest in South Dakota. The greatest

difference is between (A) (even (B)) and (C), where Kansas is very nearly equal to (A) and, especially, to Minnesota in (B). The frequency of the large urban settlements in general agrees with the preceding, but the disproportion is greater, the exceptions, Kentucky and Kansas, being evident (see Table I).

Now it will be of interest to note the data for river and lake territories. These are grouped, as above, by county belts averaging 10 to 25 miles in width.

	Population per sq. mile	Distances in miles between incorp. places: All	Distances in miles between incorp. places: 500 and upwards
Lake Erie (Ohio)	156·0	7·0	8·2
Lake Huron (Mich.) to 44° N. lat. ...	59·0	9·3	11·9
Lake Huron (Mich.) from 44° N. lat. ...	18·7	13·4	21·2
Lake Michigan (Mich.) to 44° N. lat. ...	67·0	8·9	10·7
Lake Michigan (Mich.) from 44° N. lat.	31·0	10·0	12·7
Lake Michigan (Wis.) to 44° N. lat. ...	405·0	7·1	8·15
Lake Michigan (Wis.) from 44° N. lat. ...	57·7	13·0	16·7
Peninsula of Upper Mich. (L. Michigan and Huron)	16·3	23·1	26·4
Peninsula of Upper Mich. (Lake Superior)	20·3	21·9	22·4
Lake Superior (Wis.)	23·3	20·9	28·0
Lake Superior (Minn.) (two extreme N.E. counties)	2·8	42·5	60·0

Comparing the foregoing data with those for the entire state, we see that the differences are slight, favouring the lake shores, with the exception of the sections stretching to the north. This is true not only of lake shores, though, for instance, the northern border belt in North Dakota has the corresponding data: 10·3—11·9—22·8 as far as 100° W. long., and then 8·2—13·2—33·1. But a similar dry belt in Wisconsin falls far behind the average for the state; for it has 13·7—22·8—27·8. In contrast to this the southern border line presents the following figures:

	Kansas	Missouri	Kentucky
Population per sq. mile	22·0	27·6	44·0
Distances in miles between all the incorp. places	12·7	12·3	12·4
500 and upwards	16·5	17·0	17·5

In the river belts we find urban settlements with less frequency only along the upper courses and usually with greater frequency along the lower courses than the average for the state. None of the foregoing data dealing with river-bank and lake-shore territories furnish clear and distinct evidence that these territories have a greater number of large urban settlements. A more detailed treatment is

impossible in a paper like this. If larger cities of 25,000 inhabitants and over are taken into account, it will become evident from a study of any map that in the territory studied large urban centres are by no means necessarily associated with the natural location of large bodies of water. We see that in such cases as Akron and Columbus, Ohio; Indianapolis, Indiana; Grand Rapids and Flint, Michigan; and Des Moines, Iowa. Towns of 25,000 and over are rather scarce along the large bodies of water with the exception of such huge monsters as Chicago-Milwaukee, Cleveland, Detroit, St Louis, and Kansas City. A closer study discloses the fact that towns of 25,000 to 100,000 are to be largely found along the central belt from north-eastern Ohio to the Mississippi, and in south-central Michigan, where, however, they are outside of the water belt. Elsewhere they are scattered and at some distance from large rivers, as Lincoln, Nebraska.

Below we have the river territories:

		Population per sq. mile	Distances in miles between incorp. places	
			All	500 and upwards
Mississippi	The source territory to 47° N. lat. (Minn.)	8·0	15·9	24·4
	47°–46° N. lat. (Minn.) ...	13·7	14·9	22·0
	From 46° to Minneapolis dist.	33·0	7·8	12·3
	From 43° 30′ in Minn. ...	38·4	8·7	13·6
	Left bank in Wis.	37·7	9·1	11·3
	Iowa	64·0	7·1	11·6
	Missouri	41·5	8·1	11·5
	Illinois to S. border of Iowa	71·8	8·3	10·6
	Illinois to Missouri border ...	82·0	7·1	9·5
Missouri	N. Dak. right bank	5·4	22·8	37·6
	N. Dak. left bank	7·7	17·6	32·6
	S. Dak. right bank	3·7	23·2	30·3
	S. Dak. left bank	7·7	17·1	23·6
	Nebraska, N.E.	20·6	9·3	13·1
	Dist. of Omaha	164·0	7·56	12·2
	Nebraska, S.E.	33·1	7·56	13·9
	Iowa	46·3	8·25	11·5
	Kansas	66·2	8·8	11·7
	Missouri, border	66·5	8·0	12·4
	Missouri, left bank	33·4	9·0	13·1
	Missouri, right bank ...	37·0	8·8	13·7
Ohio	Ohio	188·0	7·3	7·7
	Indiana	76·3	8·5	12·1
	Illinois	45·0	6·6	8·2
	Kentucky	56·0	8·4	12·2
Platte	To 100° W. long. (without Omaha dist.)	26·2	9·1	14·3
	From 100° W. long. (Nebr.)	8·5	19·3	24·0

For the sake of exactness it must be added that in the belt along Lake Erie the county in which Cleveland is located was left out, likewise the section south of Lake Michigan, including Chicago, and the districts including Detroit, Kansas City, and St Louis. Even if these terraines were included (as has been done in the study of the states), this does not alter the density of settlements as much as the density of population. For instance, the belt along Lake Erie with the county of Cuyahoga has 337—6·3—7·3, and the metropolitan district of Detroit 752—7—7·45.

Speaking of population and comparing the density of habitation with the density of towns, we do not discover any constant correlation, not to mention proportion, between the two (see Table II and the data about lake and river belts). A similar result is obtained from a comparison of the frequency of urban settlements with the percentage of the "urban population," *i.e.* the population of the "incorporated places" of 2500 and upwards. The same holds good of the relation of population in all incorporated places.

The limited time allowed for this paper does not permit us to deal with the question of the relation of habitation and population (of population and its density) to the number of urban settlements. For the same reason we cannot enter into a discussion of the theory of urbanization nor of the methods of this department of science, even from the standpoint of pure geography. However, we have enough evidence in the foregoing comparative study to warrant us in drawing the conclusion that urbanization as a landscape phenomenon should be studied first of all in the numerical appearance of urban settlements upon the surface of the land rather than by inquiry into their size—the number of their inhabitants and their internal structure. A study of urbanization exclusively by the methods of percentages of urban population in relation to the total population is inadequate and may even lead to error. To prove that, it is sufficient to make a comparison of the state of Illinois with Ohio, and of Iowa with neighbouring states. Neither percentage nor the number of population can possibly give us even an approximate number of such outstanding landscape phenomena as urban settlements.

SECTION E. 19–24 July

19 July

UNE ENQUÊTE MANQUÉE: LES CASSINI ET LEURS TRAVAUX CARTOGRAPHIQUES

SIR GEORGE FORDHAM

Il y a trente-trois ans feu Ludovic Drapeyron présenta au sixième Congrès International de Géographie tenu à Londres en 1895 une communication sur *La Vie et les Travaux Géographiques de Cassini de Thury*. Déjà il avait lu, au Congrès des Sociétés Savantes de cette même année, une *Première Enquête* sur ce sujet. Il présenta ensuite au Congrès des Sociétés Savantes, tenu à la Sorbonne en 1896, un travail intitulé: *Suite de l'Enquête sur la grande carte topographique de France de Cassini de Thury*, publié dans la *Revue de Géographie*, juillet–décembre 1896. Il rassembla ainsi une quantité de notes, titres et documents inédits constituant dans l'ensemble une base pour une œuvre complète sur la vie et l'activité cartographique de la famille Cassini et de ses collaborateurs, et sur l'immense travail de César-François Cassini de Thury, qui marque une époque sans pareille dans le progrès et le développement mondiaux de la science et de l'art cartographiques.

Mais Drapeyron est mort en 1901, sans, apparemment, avoir tenté l'achèvement de l'œuvre qu'il envisageait pendant ces dernières années de sa vie, et aucun effort n'a été fait ailleurs, que je sache, pour reprendre et pour mener à bonne fin cette tâche.

En attendant, cependant, un volume (le premier) de l'*Histoire de l'Observatoire de Paris*, de C. Wolf a paru à Paris en 1902, qui résume cette histoire, de la fondation de l'Observatoire en 1667 à 1793. Dans ce volume on trouve une quantité de détails très complets sur la famille Cassini, et des aperçus importants sur leurs travaux cartographiques, quoique, étant une histoire de l'Observatoire, l'astronomie et l'administration prennent, naturellement, la première place dans ce texte. En appréciant à sa valeur cette œuvre importante et des plus intéressantes, elle n'offre point de réponse, sauf dans une mesure très limitée, aux questions posées, ou suggérées, dans l'enquête de Drapeyron, et il me paraît utile, dans ces circonstances, d'attirer l'attention du Congrès actuel très particulièrement sur l'œuvre ébauchée dans son sein dès le Congrès International de Londres de 1895, dont la considération puisse être, peut-être, référée maintenant à une Commission, ou autrement développée dans une direction utile—sans

préjudice, d'ailleurs, des efforts possibles de l'énergie personnelle et privée des personnes compétentes dans la matière.

Ludovic Drapeyron naquit à Limoges le 26 février 1839, et il mourut le 9 janvier 1901. Il fut le fondateur, en 1876, et de son vivant le rédacteur en chef de la *Revue de Géographie*. Docteur ès Lettres de l'Université de Paris en 1869, il fut nommé professeur d'histoire au lycée Henri IV cette même année. Une longue notice, avec portrait, de ce savant géographe se trouve dans la *Revue*, vol. 48 (1901) à la page 81 et suivantes, et je n'ai prétention de revoir ici cette vie laborieuse et productive. Je tiens, cependant, à signaler l'importance de son projet relatif à l'œuvre cartographique de la famille Cassini, car, quoique Drapeyron ait paru se concentrer sur la carte de France, œuvre de Cassini III (César-François), complétée par Cassini IV (son fils, Jean-Dominique), à mon avis une étude complète de l'effort cartographique doit comprendre aussi la base astronomique établie au dix-septième siècle par Cassini I (aussi Jean-Dominique).

C'est l'ensemble de cette grande structure qu'il serait à propos de considérer, afin de donner au public et à la science une vue complète de la genèse et de l'œuvre de la triangulation de la France, et de la construction de la grande carte du royaume du dix-huitième siècle.

De même, il y a unité dans cette famille remarquable, et l'étude de leurs vies et de leurs idées se continue et doit être associée étroitement aux produits divers de leur longue activité. Cela a été bien compris par l'auteur de l'*Histoire de l'Observatoire*, et je me permets de préconiser comme désirable, une œuvre dans ce même genre d'idées, consacrée aux travaux cartographiques et astronomo-cartographiques de cette famille. C'est un travail important, tentant, peut-être, et sans doute d'assez longue haleine. On pourrait discuter et expliquer en détail, soit le travail déjà accompli par Drapeyron, et son utilité comme base de l'œuvre complète projetée, soit l'étendue propre à être donnée à cette œuvre.

Cependant, quoique ces sujets présentent un certain intérêt, et se prêteraient à une telle discussion, je ne suis pas convaincu de sa valeur positive dans un congrès international, et je me borne à soumettre ces courtes notes et ces indications suggestives, comme suffisantes pour le moment pour mettre en avant la possibilité de faire revivre les projets de Drapeyron présentés au Congrès de Londres de 1895, et de les présenter de nouveau ici aujourd'hui.

GÉNÉRAL PERRIER: Dans l'ouvrage du Gén. Berthaut, alors directeur du Service géographique de l'Armée, publié en deux gros volumes vers 1900,

"la Carte de France," et surtout consacré à notre carte au 80,000^e, dite État-major, on trouve une partie, assez étendue, consacrée à la carte des Cassini, fort intéressante, mais qui gagnerait encore à être complétée. Il convient de signaler que les documents techniques de la Carte de Cassini remplissent de nouveaux cartons à la Section de Géodésie du Service géographique de l'Armée. La Société astronomique de France a eu récemment à s'occuper de la restauration de la tombe de Cassini de Thury. Mener à bonne fin le projet de Ludovic Drapeyron mérite certainement de tenter quelque admirateur de l'œuvre de la dynastie des Cassini.

SIR GEORGE FORDHAM: Les relations entre l'œuvre cartographique des Cassini, la Carte de l'État-major français, l'immense carte des Pays-Bas autrichiens de la même époque et les cartes anglaises de l'*Ordnance Survey* ont beaucoup d'intérêt, et elles ouvrent un grand champ pour la discussion. Je ne me suis pas aventuré sur cette voie. J'ai tâché seulement d'attirer l'attention de ce Congrès sur l'enquête ouverte au Congrès de Londres d'il y a trente-trois ans, et de plaider l'importance de compléter ce travail sur l'histoire de la cartographie française.

L'ŒUVRE GÉOGRAPHIQUE DE LA FRANCE DANS LE LEVANT DU XVII^e AU XIX^e SIÈCLE

M. HENRI DEHÉRAIN

Levant est un bien vieux mot français dont il m'a été donné un jour de saisir la profonde signification.

Une nuit, le bâtiment sur lequel, naviguant depuis cinq jours, j'allais en Égypte s'étant arrêté, je quittai ma cabine et montai sur le pont. Nous étions devant Alexandrie. La nuit était encore noire, mais bientôt à l'est apparut une bande lumineuse de couleur exquise. Puis graduellement, tout l'orient s'illumina. Des teintes à la fois brillantes et nuancées frappèrent ma vue. Elles étaient toutes nouvelles à mes yeux.

Entre ces pays baignés par la Méditerranée orientale et les nôtres, les différences sont multiples et variées. Mais pour un nouveau venu ce qui les caractérise d'abord c'est cette couleur du ciel au lever du soleil. Quelle justesse d'observation dans ce vieux terme géographique, *Le Levant*! Par le mot de Levant nous entendons l'Anatolie, la Syrie, la Palestine et la Mésopotamie. Nous y avons depuis huit siècles beaucoup agi. Les Croisés y ont fondé des royaumes, construit des églises et des châteaux forts, dont les vestiges font l'étonnement des touristes et la joie des archéologues. Entre les Échelles du Levant et Marseille, les relations commerciales ont été continues et actives. Nous avons entretenu des consuls en nombre de villes.

Enfin le Levant a été l'objet de notre part de multiples recherches géographiques, ethnographiques et archéologiques. L'objet des

travaux de cette Section du Congrès étant de rechercher comment le globe a été découvert et étudié, j'ai tenté de dessiner un tableau d'ensemble de l'œuvre des Français dans le Levant. Il m'a semblé que la meilleure méthode pour faire saisir toute l'étendue de cette œuvre était de grouper par catégories ceux qui y ont participé.

I. *Les voyageurs*

Cet attrait exercé par l'Orient apparaît dans les nombreuses relations de voyage dont notre littérature française du XVII^e^ et du XVIII^e^ siècle a été enrichie.

Quelques-uns de ces voyageurs méritent d'être mis hors de pair: Jean Baptiste Tavernier fit six fois de 1638 à 1663 le voyage de Turquie et de Perse. Le P. Louis Feuillée, de l'ordre des Minimes, mathématicien et astronome, rapporta d'un voyage accompli en 1700–1701 les éléments de la première carte de la côte de l'Asie Mineure de Smyrne jusqu'à Alexandrette, fondée sur des observations astronomiques. Quelle originale et sympathique figure que celle du botaniste Jean Pitton de Tournefort! Il était né à Aix en 1656; sa réputation de botaniste étant arrivée jusqu'à la cour, il fut nommé professeur de botanique au Jardin du Roi. En 1699 le chancelier de Pontchartrain ayant proposé à Louis XIV d'envoyer dans les pays étrangers des personnes capables d'y faire des observations sur l'histoire naturelle, la géographie, le commerce, la religion et les mœurs des différents peuples qui les habitent, Tournefort partit pour le Levant.

Tournefort part donc en compagnie d'un dessinateur français, Aubriet et d'un naturaliste allemand, Gundelscheimer. Après des escales multipliées dans la mer de l'Archipel, il arrive à Constantinople. Pendant qu'au Palais de France il était l'hôte de l'ambassadeur de France, marquis de Ferriol, une chance lui survint. Il fut présenté à Nouman Köprülü, fils du grand vizir Moustapha Köprülü, qui, sur le point de partir pour son gouvernement d'Erzeroum, et n'étant pas fâché d'avoir un médecin à sa suite, proposa à Tournefort de l'accompagner. Circonstance heureuse qui permit à ce Français de pénétrer dans cette mer, dont les Turcs écartaient jalousement les chrétiens.

Tournefort s'embarqua dans une felouque, qui suivit la flottille du pacha, mais à distance, car il avait entendu l'intendant maugréer contre ces infidèles emmenés par son maître. Le 26 avril 1701, la flottille sort du Bosphore et longe lentement la côte d'Anatolie, ce qui

permet à Tournefort de visiter les petites villes d'Héraclée, de Amastris, de Sinope, de Samsoun, de Trébizonde, dont on avait presque perdu le souvenir en Europe.

A Trébizonde il débarque; la caravane du pacha qui ne comprenait pas moins de six cents personnes se forme et se met en marche pour Erzeroum. Les mouvements se faisaient toujours en musique, mais toujours sur le même air, "comme si les musiciens n'eussent sçu qu'une seule chanson."

Pendant qu'il séjournait à Erzeroum en juin 1701, Tournefort fit une excursion dans le massif montagneux situé à l'est de cette ville. Il découvrit les sources de l'Euphrate occidental ou Karasu. Quand Xénophon avait fait sa montée, son *anabase* vers la mer Noire, c'était la branche orientale de l'Euphrate qu'il avait traversée.

Tournefort a laissé un récit si savoureux de cette excursion qu'on ne peut résister au plaisir de le citer. S'engageant dans la montagne sous la conduite d'un évêque arménien, il arriva aux sources de l'Euphrate. "On voit," écrit-il, "je ne sais combien de fontaines sur le haut de ces montagnes: les unes coulent tout simplement, les autres bouillonnent dans de petits bassins bordez de gazon. Nous choisimes un des plus jolis gazons pour étendre notre nappe et pour nous délasser avec du vin du monastère, qui valoit mieux que tout le vin d'Erzeroum."

Cependant, des Kurdes qui erraient dans le voisinage causaient quelque frayeur à notre botaniste; il en fait l'aveu franchement, de même qu'il avoue ingénument comment il se donnait du cœur:

"Il n'y avait qu'une chose qui troubloit nos innocents plaisirs, c'est que de temps en temps nous voyions venir à nous certains deputez des Curdes qui s'avançoient à cheval, la lance en avant pour s'informer quelles gens nous étions. Je ne sçais même si la peur ou le vin n'en faisoient pas paroitre deux pour un, car à mesure que la peur s'emparoit de notre âme, il falloit bien avoir recours au cordial. S'il est permis de boire un peu plus qu'à l'ordinaire, c'est en pareille rencontre, car sans cette précaution l'eau de l'Euphrate auroit achevé de glacer nos sens."

Cette course heureusement terminée, Tournefort traversa la Géorgie et s'avança en Perse. Le 10 août 1701, il fit l'ascension du mont Ararat, jusqu'à la limite des neiges éternelles et rapporta une description de cette montagne célèbre. Puis, prenant le chemin du retour il traversa l'Asie mineure. Il s'embarqua à Smyrne et le 3 juin 1702 il revenait à Marseille. Ce voyage est resté justement célèbre.

Herborisant sans arrêt, Tournefort rapporta des graines de plantes qui enrichirent le jardin du Roi et de nombreux jardins botaniques d'Europe.

Il décrivit des pays, qu'on ne connaissait plus en Europe occidentale que par les auteurs classiques. Et puis sa relation est écrite sur un ton de sincérité et de bonhomie, qui en rend la lecture extrêmement plaisante.

Bien d'autres après Tournefort visitèrent le Levant dans le courant du XVIIIe siècle : l'antiquaire Paul Lucas, Corneille Le Bruyn, Tollot, le philologue Jean Otter, le peintre Cassas et enfin Volney, dont le *Voyage en Syrie et en Égypte* obtint un grand succès et qui fut le livre de chevet des officiers de l'armée d'Orient.

Tel fut l'attrait exercé par le Levant que les incommodités des voyages étaient facilement acceptées. Quelle différence pourtant entre nos usages et ceux régnant il y a cent vingt ans !

Nous prenons dans une agence, mettons, puisqu'il s'agit de la Syrie, l'agence des Messageries maritimes, un billet de passage pour un paquebot qui part de Marseille à jour et à heure fixes. A bord nous habitons une cabine confortable, nous avons à notre disposition des salons luxueux ; on nous sert des repas que d'aucuns trouvent trop abondants, et au jour indiqué nous débarquons à Beyrouth.

Combien jadis on voyageait différemment ! Il n'existait pas de bâtiments spécialement affectés au passage des voyageurs. Arrivé à Marseille le voyageur devait s'enquérir lui-même sur le port des bâtiments de commerce en partance pour le Levant, s'entendre avec un capitaine sur le prix du passage, et prendre lui-même ses dispositions pour sa vie à bord. Qu'on me permette de prendre un exemple dans des lettres conservées à la Bibliothèque de l'Institut et dont la citation convient d'autant mieux ici que leur auteur porte un nom illustre dans la géographie.

En octobre 1814, Guillaume Barbié du Bocage, élève de l'École des jeunes de langue de Péra, part pour Constantinople en compagnie d'un camarade qui devait laisser un nom réputé dans l'orientalisme, Pierre Caussin de Perceval. Or, nous possédons les lettres adressées par Guillaume Barbié du Bocage à son père, qui était géographe du Ministère des Affaires Étrangères, professeur de géographie à la Faculté des Lettres de Paris et membre de l'Institut.

Arrivés à Marseille, les deux jeunes gens trouvent assez facilement, grâce à un fonctionnaire établi dans la ville, à prendre passage sur un petit brick de commerce, *le Bienfaisant*, capitaine Rouvierre, qui transporte à Constantinople du papier, de la faïence et des bouteilles.

Dans le brick, il n'y a qu'une cabine commune et elle est si basse qu'un homme de haute taille ne peut s'y tenir debout. Au milieu une table pour les repas. Autour quatre cadres superposés deux à deux où couchent capitaine et passagers. Chacun doit apporter ses objets personnels, matelas, traversin, couverture, timbale, couvert. Le capitaine Rouvierre a par exception embauché un cuisinier; il s'est chargé de fournir les grands vivres, mais Barbié du Bocage est obligé de veiller à l'approvisionnement.

"Nous tourmentons souvent notre capitaine," écrit-il, "pour lui recommander nos provisions de viande. Ils ont tous besoin qu'on leur rafraîchisse la mémoire. Nous lui avons parlé d'un bœuf entier pour qu'il en prenne un quart, de plusieurs moutons pour qu'il se munisse au moins d'un."

Voilà quelles étaient encore en 1814 les conditions des voyages du Levant. Avec les facilités, ils se sont multipliés au XIX^e^ siècle.

Remarquons encore que l'Orient a eu le privilège de provoquer l'attention de nos grands littérateurs.

Chateaubriand donne le branle en 1806 et rapporte son fameux *Itinéraire de Paris à Jérusalem*. Combien d'autres après lui ont fait leur "Enquête aux pays du Levant" pour reprendre la formule de Maurice Barrès.

II. *Les officiers*

Tous les ouvrages que nous venons de citer appartiennent à la catégorie des impressions de voyage. Ce sont des descriptions, écrites en un style souvent très agréable et quand Chateaubriand tient la plume, magnifique, mais ce sont toujours des descriptions de caractère subjectif.

Nos officiers des armées de mer et de terre ont contribué à la Géographie du Levant par des œuvres d'un tout autre ordre: des cartes et des plans.

Depuis trois siècles les officiers de marine ont poursuivi d'une manière continue la reconnaissance des côtes d'Anatolie et de Syrie. Aux croquis sur lesquels les côtes étaient tracées d'une manière approximative ont succédé des cartes où ces mêmes côtes sont représentées d'une manière de plus en plus exacte. Graduellement on est arrivé à la précision qui caractérise actuellement les cartes en service à bord des bâtiments, et dont les savants ingénieurs hydrographes de la marine sont les auteurs.

La belle collection de cartes conservée dans les Archives du Service

hydrographique de la marine à Paris permet de suivre le progrès des connaissances. On a établi des cartes générales des côtes et des cartes particulières des mouillages.

Beaucoup de celles du XVII^e et du XVIII^e siècle sont anonymes. Quelques-unes pourtant sont signées et on y relève les noms de "gardes de la marine," de pilotes entretenus et d'officiers. Un certain de Combes a dressé en 1686 des cartes des Dardanelles et du Bosphore, de Champigny des cartes des côtes de Syrie en 1699. Le garde de pavillon Denouville a dessiné à bord du *Mercure* en 1721 une série de vues charmantes de Constantinople, où nous voyons le sérail au milieu des jardins de cyprès, puis tous les célèbres monuments, Sainte Sophie, la Solimanié, la mosquée du sultan Achmet. Pendant la campagne accomplie en 1777 le long des côtes de Caramanie par la "barque du roi" *L'Éclair*, commandée par le comte de Forbin, les enseignes de vaisseau de Beaumont et de Moissac et le pilote Pourquier levaient le plan des golfes de Macari et des Scopes.

Le lieutenant de vaisseau Truguet (qui devint vice-amiral et ministre de la marine sous le Directoire) commandant la corvette *Le Tarleton* établit en 1785–1786 avec le concours de Tondu, astronome élève de Cassini, plusieurs cartes des côtes d'Asie Mineure. Celles de Syrie furent en 1817 l'objet d'un relevé général par le capitaine de vaisseau Gauttier commandant la gabare *La Chevrette*.

Pendant le XIX^e siècle les travaux de reconnaissance des côtes du Levant se multiplient. Nous regrettons de ne pouvoir citer les noms des nombreux officiers, qui y ont apporté leur concours. Mais comment omettrions-nous de rappeler qu'en 1854 un enseigne de vaisseau appelé à devenir l'une des gloires de la marine française, Courbet, dressa un plan de la rade d'Alexandrette?

Les cartes modernes sont admirables d'exactitude et de précision; mais les cartes anciennes, si elles manquent de rigueur l'emportent en fantaisie décorative. Voici, par exemple, une légende ingénue qui figure sur une carte manuscrite de la rade de Tyr datant du XVII^e siècle. Au-dessus d'un groupe de ruines on lit: "Sour ou les ruines de Sur, Tiro ou Tyr, où il y a une colonne d'une longueur et grosseur extraordinaire que l'on prétend être celle que Samson renversa." Suivent des renseignements utiles: "le mouillage y est fort bon et même dans l'hiver les marchands qui craignent la rade de Saint Jean d'Acre et de Saïde y viennent mouiller pour y faire leur chargement; l'on n'y trouve aucun vivre hormis quelque rafraîchissement."

Les cartes des Dardanelles faites par Truguet sont ornées de vues de monuments, de ruines, de marines dues au talent d'un peintre d'une

certaine notoriété, Cassas, qui fit partie du groupe dit "les peintres du Bosphore."

Les travaux géographiques des officiers de l'armée de terre ne l'ont pas cédé en valeur à ceux de leurs camarades de la marine.

Des deux campagnes faites en Syrie par les armées françaises en 1799 et en 1860 la géographie a bénéficié.

Un aide de camp du général Kléber, Charles Paultre, dressa au Caire une *Carte physique et politique de la Syrie pour servir à l'histoire des conquêtes du général Bonaparte en Orient* qui fut publiée à Paris dès l'an VIII, 1800.

Mais le plus important travail géographique qui résulta de la campagne de Syrie, ce furent les cinq cartes de Gaza, Jérusalem, Césarée, Acre et Tyr dressées par le chef des ingénieurs géographes Jacotin, et qui sont annexées à la grande carte d'Égypte au 100,000^{e}. En des paroles qui ne manquent pas d'une légitime fierté, Jacotin a exposé au milieu de quels dangers il travailla.

"L'occupation de la Syrie par l'armée d'Orient exigea la construction d'une carte de la partie de cette contrée qu'elle a parcourue et qui a été comme l'Égypte le théâtre de sa valeur. Étant le seul ingénieur géographe que le général en chef ait emmené à l'armée de Syrie, quelque zèle et quelque activité que nous ayons mis dans nos travaux, il nous a été impossible de toujours donner à nos opérations l'exactitude que nous aurions désirée. Nous étions au milieu d'une armée toujours sur le qui-vive, qui se battait fréquemment et qui traînait à sa suite la famine et la peste; en outre on ne pouvait s'écarter sans tomber dans les mains des arabes, plus à craindre encore. Il nous est arrivé particulièrement aux sièges de Jaffa et d'Acre, et au retour de l'armée en Égypte, d'opérer sur le terrain environné des victimes de ces trois fléaux; mais le désir de faire connaître un pays curieux sous tant de rapports nous faisait braver tous les dangers et détournait les tristes réflexions que faisaient naître à chaque pas les objets et les scènes funestes qui étaient sous nos yeux."

Soixante ans plus tard une autre armée française parut dans le Levant. A la suite des massacres des chrétiens dans le Liban et à Damas par les Druses, les musulmans et les Turcs, un corps d'armée français fut envoyé dans le Liban pour "aider le sultan à rétablir la paix." L'occupation dura d'août 1860 à juin 1861. Une brigade topographique recueillit les éléments d'une carte au 200,000^{e} en une feuille qui fut publiée en 1862 sous la signature des capitaines d'état major Gelis et Nau de Champlouis.

III. *Les archéologues*

Voyageurs et officiers sont venus en Orient dans le dessein arrêté d'y faire des observations et des études topographiques.

Mais la géographie a encore bénéficié d'une manière indirecte des travaux d'autres Français que les circonstances de leur carrière avaient amenés en Orient. Leurs études géographiques ont été faites par surcroît et en manière d'addition à leurs autres travaux. Arrêtons-nous d'abord sur l'œuvre géographique des archéologues.

Partis de France dans le dessein de rechercher les vestiges des civilisations anciennes qui se sont succédé sur le sol de l'Orient, certains d'entre eux ont en outre rapporté des descriptions et des cartes du pays.

La Syrie et la Palestine ont été au XIX^e siècle explorées par une équipe d'archéologues français passionnément épris de science et en même temps pourvus de puissants moyens matériels. En même temps que l'histoire ancienne et médiévale la géographie a bénéficié de leurs recherches. L'ouvrage de Victor Guérin est intitulé *Description géographique, historique et archéologique de la Palestine*; Guillaume Rey rapporta de ses voyages non seulement une *Étude sur les monuments de l'architecture militaire des Croisés en Syrie*, et son ouvrage célèbre: *Les colonies franques de Syrie aux* XII^e *et* XIII^e *siècles*, mais encore une *Carte de la montagne des Ansariés et du pachalik d'Alep* (1866); il publia plus tard une carte du nord de la Syrie (1885). William Henry Waddington en même temps qu'il recueillit et déchiffra de nombreuses inscriptions au sud de Damas fit véritablement œuvre de géographe par sa description tout à fait neuve des régions montagneuses de la Syrie orientale, Hauran et Safa. Des voyages du duc de Luynes l'archéologie a tiré maint bénéfice. Le Louvre s'est notamment enrichi du célèbre sarcophage du roi Ech-Mounazar, mais la géographie en même temps lui est redevable d'excellentes cartes du Ouadi el Araba (dépression qui s'étend de la mer Morte à la mer Rouge) dressées sous sa direction par le lieutenant de vaisseau Vignes.

Poursuivant brillamment cette tradition, M. René Dussaud a fait œuvre à la fois archéologique et géographique au cours de ses voyages dans la vallée de l'Oronte, les monts Ansarieh, le Safa et le désert de Syrie.

Comment enfin omettre de rappeler la part qui revient dans notre connaissance géographique de l'Orient à nos Instituts savants, laïques et religieux, qui à pied d'œuvre s'y sont établis de longue date.

Depuis Georges Perrot, qui en 1861 rapporta de son voyage fameux en Galatie le texte inédit du testament d'Auguste gravé sur les murs du temple d'Ancyre, plusieurs membres de l'École française d'Athènes ont parcouru l'Asie mineure. En même temps qu'ils récoltaient des documents archéologiques ils glanaient des remarques géographiques. Les professeurs et les élèves de l'École Saint Joseph de Beyrouth se sont répandus dans la région d'Alep, dans la Damascène et jusqu'à Pétra. Et les membres de l'École biblique Saint Étienne de Jérusalem ont audacieusement et courageusement poussé leurs investigations savantes jusqu'en Arabie.

IV. *Les consuls et les interprètes savants*

Au progrès des connaissances, une dernière catégorie de Français a contribué, qui passèrent de longues années dans le Levant, certains même toute leur vie, une catégorie de travailleurs sédentaires, des consuls et des interprètes, qui occupèrent les nombreux postes que la France entretint du XVIe au XIXe siècle dans le vaste ancien Empire ottoman, du Danube au golfe Persique, de la Crimée au Nil.

Colbert s'était promptement avisé des concours que nos agents du Levant pouvaient rendre aux études. Dans une circulaire du 29 novembre 1672 il leur recommandait de rechercher des manuscrits.

"Estant bien aise de faire recherche de manuscrits pour mettre dans ma bibliothèque, comme je ne doute pas que vous ne trouviez avec facilité plusieurs occasions d'en avoir; vous me ferez plaisir de vous en informer et de n'en pas laisser échapper aucun, lorsque vous en trouverez, sans les acheter."

Nombreux furent les agents, qui enrichirent nos collections par l'acquisition de manuscrits et de médailles, qui firent des découvertes archéologiques et qui enfin contribuèrent au progrès des connaissances géographiques.

Donnons quelques exemples. Le chevalier Laurent d'Arvieux, consul général à Alep de 1679 à 1686, qui possédait le rare avantage de pouvoir négocier en langue turque avec les pachas turcs, constitua un dossier considérable de notes dont, après sa mort, survenue en 1702, le P. Labat tira la matière de six volumes de Mémoires, contenant, dit le titre, "ses voyages à Constantinople, dans l'Asie, la Syrie, la Palestine, l'Égypte et la Barbarie, la description de ces pais, la religion, les mœurs, les coutumes, le négoce de ces peuples et leurs gouvernements, l'histoire naturelle et les évènemens les plus considérables." A Poullard, consul à Tripoly de Syrie, on doit la première description, en 1705, des ruines de Baalbek.

A Charles de Peyssonel, qui fut consul à Smyrne de 1747 à 1757, on doit une bonne carte de la côte d'Asie, de Smyrne au golfe d'Adalia.

L'orientaliste Venture de Paradis, qui devait être premier interprète de l'armée d'Orient et jouer auprès du général Bonaparte pendant la campagne d'Égypte le rôle de conseiller technique, avait pendant qu'il occupait le poste d'interprète à Seyde de 1764 à 1768 rassemblé les éléments d'un excellent *mémoire sur les Druses, peuples du Liban* (*Annales des voyages*, t. IV, 1809). Arrêtons-nous enfin sur la carrière de deux agents du Levant, qui figurent des types représentatifs des consuls savants. Le premier est Joseph Rousseau. Fils d'un consul, qui était lui-même orientaliste, élevé à Bagdad, Joseph Rousseau partagea sa vie de propos délibéré entre ses fonctions diplomatiques et les recherches savantes. Il débuta en 1807 comme secrétaire de la mission Gardane. Nommé en 1808 consul général à Alep, il s'y fixa. Il fut un auteur fécond. Il donna notamment en 1809 une *description du pachalik de Bagdad* et en 1818 un *mémoire sur les trois plus fameuses sectes du Musulmanisme, les Wahabis, les Nosaïris et les Ismaëlis.*

Mais ici nous devons surtout retenir une carte qu'il publia en 1825 sous les auspices de la Société de géographie et intitulée: *Carte d'une portion du Scham* (*la Syrie*), *du Djéziré* (*la Mésopotamie*), *et de l'Iraq Arabi* (*la Babylonie*) *contenant les trois paschaliks de Haleb, Reha ou Orfa et Baghdad, dressée de* 1811 *à* 1818.

Non moins ardent aux recherches que Joseph Rousseau fut son camarade Pascal Fourcade, consul général à Sinope de 1803 à 1809. Il professait qu'un agent doit étudier le pays de sa résidence. "J'ai cru, Monseigneur," écrivait-il le 15 avril 1807 à Talleyrand, ministre des Relations Extérieures, "que vous ne regarderiez pas comme remplissage ou hors d'œuvre ce que je me permets dans mes dépêches au sujet des antiquités, de la géographie et de la botanique."

Conformément à ce principe, Pascal Fourcade étudia l'histoire et la géographie de Sinope et de ses environs et fit trois voyages dans les vallées des deux grands fleuves de l'Anatolie du nord, l'Halys et l'Iris.

Il dressa une Carte du Pont Galatique et de la Paphlagonie; puis la commenta dans un excellent mémoire. Il décrit l'Halys, dont le cours est vagabond, rapide, qui entraîne des arbres déracinés, d'énormes rochers et "qui rejette bien loin toutes les habitations." Il lui oppose l'Iris, "qui couronne ses rives de trembles, de peupliers, de platanes, de saules pleureurs, qui s'écarte peu, enrichit beaucoup et ne fait jamais autant de mal que son voisin." Il décrivit les villes du Pont et celles de la Paphlagonie. Antiquaire en même temps que géographe, il fut le premier explorateur qui reconnut que la métropole

de la Paphlagonie, Pompeiopolis, était située sur l'emplacement de la ville actuelle de Tasch Keuprou. Bref Pascal Fourcade, qui mourut prématurément à Salonique en 1813, accomplit dans l'Anatolie du nord une œuvre géographique considérable, qui est restée en grande partie inédite.

J'ai cité ces travaux à titre d'exemple, mais bien d'autres agents consulaires que Joseph Rousseau et Pascal Fourcade contribuèrent au progrès des connaissances. Comment omettre de rappeler ici le nom de Charles Clermont-Ganneau, qui, drogman chancelier à Jérusalem, puis vice-consul à Jaffa, débuta dans la carrière scientifique par un triomphe, la découverte de la fameuse stèle de Mesa, qui commémore la victoire du roi de Moab sur Achab.

Par leurs correspondances ces agents ont enrichi singulièrement notre *Bulletin de la Société de Géographie.*

Conclusion

Essayons en terminant de résumer les caractères généraux de cette œuvre géographique.

Et d'abord la continuité. Depuis trois siècles le Levant n'a pas cessé de solliciter notre curiosité. L'effort a varié d'intensité, mais il n'a jamais été interrompu. Dans le Levant nous ne nous sommes jamais laissé oublier.

Ensuite la diversité des professions de ceux qui ont pris part à cette étude.

Voyageurs amateurs, voyageurs savants, voyageurs hommes de lettres, marins, militaires, archéologues, religieux, consuls, interprètes y ont concouru simultanément.

Enfin le Levant a eu le privilège d'exercer son attrait sur quelques-uns des hommes dont l'esprit français peut à juste titre se glorifier. Parmi les noms que j'ai cités, vous en avez reconnu beaucoup d'éminents et quelques-uns d'illustres. La valeur des ouvriers constitue encore un caractère de cette œuvre.

Les voyageurs, les officiers, les archéologues, depuis 1920, depuis que la France exerce dans le Levant le mandat qui lui a été conféré par la Société des Nations, l'étudient plus activement que jamais; nous sommes donc les continuateurs d'une œuvre scientifique, dont les origines remontent loin dans le passé.

M. CH. DE LA RONCIÈRE, en félicitant M. Dehérain des riches données de sa communication, appelle l'attention du Congrès sur l'importance de l'immense carte de la Méditerranée par le P. Challe (1670), de 30^{mq}. Elle a servi

de base aux travaux typographiques de Pène, le fondateur du Service hydrographique, en 1680. En 1682–3, Gravier d'Ortières a dessiné les vues de la plus grande partie des villes du Levant, à une époque où Louis XIV faisait donner la chasse aux pirats barbaresques jusque dans les ports turcs.

PRESENTAZIONE DELL' OPERA "MONUMENTA CARTOGRAPHICA ITALIAE"

PROF. ROBERTO ALMAGIÀ

Ho l' onore di presentare al Congresso Internazionale di Geografia di Cambridge una raccolta di riproduzioni di antiche carte riguardanti l' Italia o territori italiani, la quale è stata da me messa insieme con ricerche prolungate per molti anni e sta per essere pubblicata dal l' Istituto Geografico Militare italiano col titolo di *Monumenta Cartographica Italiae.* La Raccolta non è ancora del tutto completa, poichè, come ben sanno coloro che si occupano di questo genere di indagini, il tempo che si richiede per raggiungere risultati, se non definitivi, almeno soddisfacenti, è sempre di gran lunga superiore ad ogni previsione. Delle 70 tavole che i *Monumenta* comprendono, ne mancano ancora quattro o cinque, e qualche altra viene ora presentata in riproduzione provvisoria; del testo illustrativo si presentano cinque capitoli, mentre mancano ancora il capitolo finale, alcune appendici e gli indici.

La Raccolta comprende i più importanti documenti di quelli che possiamo chiamare i primi periodi della cartografica moderna, dal secolo XV fino alla metà del XVII, allorchè comincia in Italia la cartografia geodetica. Sulle origini e lo sviluppo di quest' ultima, l' Istituto Geografico Militare ha già pubblicato, in occasione del suo cinquantenario, un bel volume di *Attilio Mori. La cartografia ufficiale in Italia e l' Istituto Geografico Militare, Roma*, 1922.

I *Monumenta Cartographica Italiae* abbracciano adunque l' epoca pregeodetica, che si può far cominciare col secolo XV. Ma a questo tempo esistevano già varie specie di carte, come eredità di un' epoca più antica. C' erano anzitutto le carte inserite nella "Geografia" di Tolomeo che circolava manoscritta; di esse si sono riprodotte, come saggio, nelle tav. I–II quelle contenute in un codice dei più autorevoli, e forse il più antico, il Vat. Urb. gr. 82. C' erano le carte nautiche, le quali sono ormai ben conosciute, talchè la nostra Raccolta si è limitata a riprodurne alcuni saggi nella tav. III. C' erano infine delle carte regionali, delle quali tuttavia pochissimi esemplari sono pervenuti fino a noi; nelle tav. VI e seguenti se ne trovano riprodotti alcuni tipi,

i quali, a mio avviso, rappresentano le ultime sopravvivenze di una cartografia più antica, risalente al Medio Evo e ormai in procinto di scomparire di fronte alla nuova cartografia, che si diffonde nel secolo xv. Di questa nuova cartografia vi è anzi qualche saggio che risale ancora al secolo xiv; tale è la molto discussa carta d' Italia inserita in un codice vaticano della *Cronaca* di Fra Paolino e riprodotta nella tav. IV.

Nel secolo xv circolano già parecchi tipi di carte d' Italia; uno di questi, perfezionato a Firenze, comincia, già alla fine di quel secolo, a diffondersi per le stampe. Altri tipi si aggiungono nel secolo successivo, il xvi, nel quale appaiono anche carte regionali di tipo nuovo. La cartografia si perfeziona sempre più in Italia per merito di cartografi insigni, tra i quali eccelle, come è ben noto, il piemontese Giacomo Gastaldi. La produzione cartografica diviene ormai molto abbondante, di modo che nella nostra Raccolta si è dovuto fare una scelta. I *Monumenta* riproducono circa 150 carte; si sarebbe potuto agevolmente raddoppiare questo numero, ma la pubblicazione aveva già raggiunto una mole considerevole. La scelta è stata fatta in modo da dare la preferenza alle carte più rare ed a quelle che sono veramente fondamentali per lo sviluppo ed il progresso della cartografia dell' Italia, come quasi tutte le carte del Gastaldi. Si è cercato anche di dare saggi di tutti i differenti stili delle varie scuole cartografiche. Per contro, si è rinunziato, nella maggior parte dei casi, a inserire facsimili di carte che erano già state riprodotte in modo soddisfacente in opere anteriori alla presente.

Anche fra le carte stampate, il numero di quelle che sono oggi divenute di una rarità estrema è molto più considerevole di quanto non si possa credere: fra quelle riprodotte nei *Monumenta* ce ne sono ben ventidue, delle quali si conosce finora un solo esemplare. Un lungo e paziente lavoro di ricerca ha permesso di rintracciarle dai fondi meno esplorati di Biblioteche italiane, del Museo Britannico, della Biblioteca Nazionale di Parigi, di Biblioteche tedesche, olandesi ecc.

Ma nel secolo xvi si inizia in Italia—forse prima che in qualsiasi altro paese di Europa—una cartografia che può dirsi ufficiale. In altri termini, i numerosi stati, grandi e piccoli, nei quali l' Italia era allora divisa, cominciano ad avvertire la necessità di procurarsi, con i procedimenti più esatti che allora si possedevano, una rappresentazione cartografica dei rispettivi territori. Controversie di confine e più ancora ragioni superiori di difesa militare sono stati, allora come adesso, i moventi che hanno dato origine a questa cartografia, la quale

per vero, in alcuni stati, come ad esempio la Repubblica di Venezia, fa la sua comparsa sin dal secolo XV. L' esempio di questa è ben presto seguito, e nel Cinquecento tutti gli stati italiani hanno ormai carte che si possono considerare come ufficiali. Vi sono stati in quel secolo dei cartografi di grande valore; il maggiore è il cartografo ufficiale della Repubblica di Venezia, Cristoforo Sorte, che ha eseguito delle vere e proprie carte topografiche a scale di 1 : 60,000–1 : 70,000 circa (vedere riproduzioni nelle tav. XLIII e XLIV); egli è il primo dei grandi topografi italiani, la cui tradizione si continua da allora ininterrotta fino ai nostri giorni.

Purtroppo noi non siamo bene informati sui procedimenti e sugli strumenti che questi primi topografi adoperarono nei lavori sul terreno; solo alcuni ci hanno lasciato indicazioni sugli strumenti adoperati, come il *Radio* di Latino Orsini, perfezionato da Egnazio Danti, uno strumento ideato da C. Piccolpasso, autore del rilievo del territorio perugino ecc.

Tutte quelle carte di carattere speciale ufficiale non erano affatto destinate al pubblico; al contrario, di solito venivano tenute come riservate; taluni governi le custodivano anzi come gelosi segreti. Molte di esse non avrebbero perciò esercitato probabilmente alcuna influenza sul progresso della cartografia dell' Italia, se un astronomo e geografo italiano di gran valore, il padovano G. A. Magini, non avesse dedicato venti anni della sua vita all' opera grandiosa di raccogliere e coordinare un grande Atlante d' Italia, mettendo a profitto le autorevoli sue relazioni personali e l' influenza dei suoi protettori, i duchi di Mantova, per procurarsi un gran numero di quelle carte ufficiali, che egli poi utilizzò ed elaborò con lavoro personale di critica e di sintesi. In un mio precedente studio ho illustrato tutta questa parte dell' operosità del Magini, ricostruendone il lungo e sagace lavoro; nei *Monumenta* viene riprodotta, insieme ad alcune carte speciali di lui particolarmente rare, la grande Carta d' Italia del 1608, che, cercata invano per l' innanzi da molti studiosi, io ebbi la fortuna di rintracciare qualche anno fa, e di cui finora due soli esemplari sono conosciuti.

Il testo che accompanga i *Monumenta Cartographica Italiae* non costituisce affatto una storia completa della cartografia dell' Italia per il periodo di tempo considerato; questo sarebbe compito superiore—credo—alle forze di un solo studioso. Si tratta invece di un commentario, nel quale io ho cercato in prima linea di dare, per ciascuna carta originale, tutte le notizie necessarie per identificarla agevolmente e per

distinguerla dalle successive ristampe, derivazioni e contraffazioni, spesso molto numerose, fornendo anche di queste un elenco il più possibile completo; ho esposto inoltre ordinatamente le indicazioni bibliografiche intorno agli scritti moderni sulle carte e i cartografi via via passati in rassegna.

Gli studiosi sono perciò ora messi in grado di utilizzare le carte come un documento storico; al qual fine è necessario esaminarne il contenuto, indagarne le fonti e il grado di originalità, ovvero di dipendenza da prodotti anteriori. Questo genere di studi relativi alle carte geografiche è stato finora assai poco curato; si può forse dire anzi, che le carte costituiscono la categoria di documenti storici meno studiati finora.

Alcune considerazioni generali sullo sviluppo della cartografia in Italia sono esposte, come conclusione, alla fine del commentario illustrativo, ma non è questo il luogo per farne un riassunto; la presente comunicazione aveva infatti l'unico intento di chiarire il carattere della Raccolta presentata al Congresso. È forse opportuno, invece, di accennare che Raccolte simili non sono fatte soltanto in servizio degli studi di storia della cartografia, ma, permettendo il confronto fra carte sincrone o successive di uno stesso territorio, possono tornar utili per molte specie di ricerche. Da esse si ricavano intanto preziosi dati sulla storia delle mutazioni fisiche del suolo italiano; le rappresentazioni cartografiche forniscono infatti i punti di appoggio più sicuri per seguire, ad esempio, le trasformazioni del delta del Po, o della zona Lagunare veneta, o dell' idrografia delle Romagne o della costa Toscana ecc. negli ultimi cinquecento anni.

In un altro campo, le carte offrono, a partire almeno dalla fine del Cinquecento, elementi di prim' ordine per ricostruire le variazioni dei confini e le mutazioni territoriali degli stati italiani, dandoci sicuri fili conduttori per guidarci in una storia sovente molto complicata. A questo riguardo è opportuno forse richiamare gli storici ad un' utilizzazione più larga di questi materiali cartografici, i quali possono talora risparmiare faticose ricerche d' altro genere. Se in passato non vi si ricorreva più spesso, forse ciò era anche dovuto alla mancanza di una Raccolta sistematica di queste fonti cartografiche originali; il presente lavoro sopperisce ora, in larga misura, a tale lacuna.

Non mi dilungo in altre esemplificazioni; ma gli studiosi potranno forse convenire che il tempo e la fatica necessari a mettere insieme la presente Raccolta non sono stati spesi invano.

M. EMM. DE MARGERIE, à la suite de la présentation faite par M. le Prof. Almagià, exprime la gratitude de tous les géographes étrangers à l'*Istituto*

Geografico Militare et à son éminent Directeur M. le Gén. Vacchelli pour la publication de ce magnifique ouvrage, qui vient se placer à côté de l'*Atlante di tipi geografici* précédemment édité par le même Institut et constitue un instrument de travail de premier ordre. Il espère que le vœu émit par l'orateur sera entendu et que chacun des pays de l'Europe, suivant cet exemple, tiendra à faire paraître pour son propre territoire un recueil analogue.

LA CARTA ARCHEOLOGICA D' ITALIA

GR. UFF. CONTE F. PELLATI

Per il moderno indirizzo degli studi archeologici, ogni scoperta e ogni monumento non vengono più considerati soltanto per sè stessi come unità indipendenti, ma anche e sopratutto in rapporto ad altre scoperte e ad altri trovamenti per costituire nessi e analogie destinate a gettar luce e far progredire la risoluzione dei fondamentali problemi sull' origine dei popoli, sulle forme della civiltà dell' arte e del pensiero, sulle antiche vie di comunicazione che hanno agevolato il costituirsi dei gruppi etnici. Questo indirizzo e il succedersi continuo dei trovamenti rendono non solo utile ma indispensabile l' esistenza di carte archeologiche condotte con metodo rigorosamente scientifico, le quali, mediante la fissazione topografica dei resti monumentali e la distinzione grafica di strati culturali e di momenti archeologici, rendano facilmente riconoscibile il vario sovrapporsi delle antiche genti e la fisonomia storica di una regione.

Tale necessità non si è manifestata da oggi: pur a prescindere da quanto si è tentato e compiuto in proposito nel Belgio, nella Germania, nella Francia e nell' Africa del Nord, e volendoci limitare all' Italia, basterà ricordare che una tale esigenza era stata già riconosciuta sino dal 1872 dal Senatore Torelli, in seguito ai colloqui da lui avuti con un grande cartografo, il geologo Paolo Savi di Pisa; che tra il 1885 e il 1891 un' impresa di questo genere fu già tentata, e su larga scala, per il territorio della bassa Etruria, e particolarmente per quello falisco-capenate, da un gruppo di studiosi, il Gamurrini, il Pasqui, il Cozza, il Mengarelli, i quali raccolsero un cospicuo materiale oggi esistente inedito presso il Museo di Villa Giulia; che una nuova iniziativa del genere fu presa dal Senatore Corrado Ricci, allora Direttore Generale delle Antichità e Belle Arti, negli anni 1909–1910, colla costituzione di un Comitato speciale, che però, per mancanza di adeguati mezzi finanziari, non potè condurre il suo lavoro nel campo dell' azione concreta; che una nuova Commissione del genere fu nominata nel 1921, anche questa volta senza pratici risultati per mancanza di mezzi finanziari e personali. Naturalmente, in questa enumerazione, ab-

biamo taciuto alcuni tentativi di carte parziali, e cioè limitate ad una regione, o speciali, e cioè limitate ad un tipo di monumenti, ad un gruppo etnico o ad uno strato di civiltà; tali ad esempio le cartine del von Duhn per alcune regioni della Calabria e dell' Etruria (Italische Graeberkunde), quelle del Dall' Osso per il Piceno, quelle dei nuraghi sardi, ecc.

Finalmente, in attuazione dei deliberati presi nel 1919 dalla "Union Académique Internationale de Bruxelles," l' Accademia dei Lincei ideò la compilazione della *Forma Italiae*, la quale già si è iniziata per la zona di Terracina. Ma questo lavoro è un' opera colossale che probabilmente non sarà compiuta che tra qualche secolo; è un vasto *Corpus* di tutti gli elementi archeologici dalle età più antiche sino all' alba del Rinascimento, dispersi sul nostro territorio o nei nostri Musei o dei quali è rimasta notizia, con notazioni su carte di varia ma grande scala e con un ricco corredo di illustrazioni fotografiche, di rilievi, di chiarimenti interpretativi e di notizie bibliografiche. Ma intanto la carta archeologica, non la carta di ricerca speciale ma la carta di orientamento e di ricognizione, la vera carta di uso pratico ed immediato, era sempre un desiderio. Or ecco che nel 1926, in occasione del convegno Nazionale Etrusco di Firenze e in seguito ad accordi intervenuti tra il prof. Marinelli, il Soprintendente Minto e il Generale Vacchelli, Direttore dell' Istituto Geografico Militare, veniva lanciata la proposta di una carta archeologica al 100,000; ben più, veniva presentato un saggio di tale carta per la zona di Chiusi. Tali accordi preliminari venivano prontamente integrati da nuovi e più larghi e definitivi accordi tra la Direzione Generale delle Belle Arti e il Generale Vacchelli, così che l' opportuna iniziativa poteva subito venire iniziata per tutte le regioni italiane.

La nuova carta, che è un vasto repertorio topografico, bibliografico e museografico dell' Italia antica, è stata fissata al 100,000 non solo perché tale proporzione sembrò la più adeguata per evitare così una troppo difficile lettura come un soverchio frazionamento di segni e per consentire così lo sguardo d' insieme come la facile ricognizione di ogni particolare degno di nota, ma anche perchè una carta in tale scala poteva venir fornita, come carta base, per tutta l' Italia dall' Istituto Geografico Militare. Va da sè che il lavoro preparatorio viene eseguito su schede e su tavolette al 25,000 e che alcune zone urbane o suburbane e alcuni centri antichi di maggior interesse archeologico verranno riportati sopra cartine di dettaglio di maggior scala. I segni, impressi litograficamente a più colori e con notazioni facilmente differenziabili per indicare le diverse civiltà e il vario carattere dei

monumenti, vennero scelti in guisa da offrire una sufficiente chiarezza e una rapida percezione, senza eccessive rigidità formalistiche.

Ai singoli fogli và unito un fascicoletto, desunto dagli schedari esistenti presso le Soprintendenze archeologiche, e contenente sintetiche notizie illustrative, museografiche e bibliografiche dei monumenti notati nella carta.

I fogli saranno 300: già fin da ora sono stati pubblicati quelli: 120 (Siena), 121 (Montepulciano), 129 (Santa Flora), 113 (Casciano Val di Pesa); sono in corso di stampa i fogli 27, 28 e 29 (Val d'Aosta), 102 (Ventimiglia e San Remo) e 216 (Tharros). Sono poi in uno stato di avanzata preparazione quelli di Ivrea, Susa, Torino, Finale, Savona, Firenze, Chiusi, Cortona e Perugia, Civitavecchia, Salerno, Reggio di Calabria, Dorgali e Macomer, mentre già sono iniziati quelli di Spezia, di Varallo, di Biella e di Massa Carrara.

Il lavoro procede quindi con molta rapidità ed è lecito sperare che, mercè la preziosa cooperazione dell' Istituto Geografico Militare e del suo Direttore, Generale Vacchelli, l' opera veramente grandiosa possa essere compiuta per tutta l' Italia enteo un decennio. Se per il 1938 potrà giungere a compimento, sarà questa una delle forme più degne per celebrare in quell' anno il bimillenario di Augusto, che fu, come è noto, l' istitutore della grande e classica partizione dell' Italia antica.

M. EMM. DE MARGERIE rappelle qu'en France, il y a cinquante ans, une tentative avait été faite pour établir une légende internationale, applicable aux cartes archéologiques, et qu'un certain nombre de cartes de ce genre, relatives aux contrées les plus diverses, ont été exécutées dans la suite. Il cite en outre les cartes archéologiques à grande échelle de la Tunisie et de l'Algérie, exécutées par ordre du Gouvernement Français sous les auspices de l'Académie des Inscriptions et Belles-Lettres. *La Carta Archeologica d' Italia* présentée au Congrès par M. le Comte Pellati représente toutefois, pour le continent européen, le premier effort systématique réalisé dans ce sens. Il appartenait à l'Italie, cette terre classique de l'Érudition, de donner aux géographes et aux archéologues de tous les pays un exemple qui trouvera certainement des imitateurs.

COMMENTS ON AN EXPEDITION TO SAN LORENZO DE NUTCA IN THE EIGHTEENTH CENTURY

DR H. CASTRO

Abstract

Comments from the examination of the ship's log made during a maritime expedition which took place in the eighteenth century for the occupation of the port of San Lorenzo de Nutca (to-day British Columbia) North America.

The Mexican Geographical and Statistical Society published in 1913 a manuscript by the Mexican naturalist D. José Mariano Moziño who relates the episodes of the Spanish expedition of which he formed part, which, together with an English one, commanded by Vancouver, were charged with fulfilling the agreements of a convention signed in San Lorenzo el Real by the Count of Florida Blanca and the British Plenipotentiary Tichervert. This convention put an end to an international conflict caused by virtue of a denouncement laid before the British Parliament against D. José Esteban Martinez, a Captain of the Spanish Navy who commanded the expedition which occupied the port of Nutca in 1779.

The author of this note has the honour of presenting to the Congress the ship's log of the expedition of this Spanish sailor, pointing out the most interesting anecdotes of the voyage, as well as the extracts of a geographical character contained in it, which in some places rectify those made by Moziño.

A PROPOSED MAP OF THE ROMAN EMPIRE

O. G. S. CRAWFORD

See *Antiquity*, 1929, III, p. 230, and *The International Map of the Roman Empire* (1:1,000,000): *being the 1st Report of Commission No. 7 of the International Geographical Union*, Ordnance Survey Office, 1929, 10 pp.

Two conditions have to be fulfilled before an archaeological map of a country or a continent can be constructed. First, the necessary data must have already been collected. This presupposes a long period of scientific activity and record. For prehistoric periods the data must necessarily be, at the best, fragmentary; but they need not therefore be inaccurate or misleading. For periods covered, more or less, by written records it may however be possible to produce a map of considerable fullness. The second limiting condition is the existence of a suitable base-map upon which to overprint the archaeological information. This condition is one of some practical importance when the area to be covered is large and when it would be impracticable to produce a specially drawn base-map. It becomes of vital importance when the desired area includes more than one European nation. For any large area of this kind the International Map on the scale of one to a million is clearly the ideal map.

I do not intend this morning to discuss the compilation of maps of prehistoric periods; such maps have a special technique which would require too long to explain. It is doubtful, moreover, whether the

time is yet ripe for such prehistoric maps, and a merely academic discussion, though interesting, would have no tangible result. The scheme put forward is a practical one. It concerns, not the twilight of prehistory, with its gaps, its uncertainties and its errors of the personal equation, but the full daylight of civilization. I propose that a map of the Roman Empire be compiled, for publication on the sheets of the International Map of the World on the scale of 1 : 1,000,000; and I ask the governing body responsible for that map to direct the undertaking.

The map would aim at being at first no more than a skeleton—a kind of amplified Bradshaw map of the Roman Empire. It would show all the principal settlements whose names are known and the principal Roman roads. These would be the main features, but in addition there would be indicated some important industrial regions (such as mining or pot-making districts), purely geographical names (such as those of rivers, mountains, forests and swamps), and tribal names. Military features, such as the German and Dacian walls and their associated forts would of course be shown. Broadly speaking, the model suggested is the first edition of the map of Roman Britain, published in 1924 by the Ordnance Survey of Great Britain. (Perhaps I should explain that I suggest this map as a model because no other similar map is in existence.) The utility of such a map is not open to question. Each sheet would be of immense service to students and teachers, who have nothing at present but small-scale atlas-maps. There is no reason why more detailed editions of all or any sheets should not be published later; but I am sure it is important to adopt a limited objective at the start, and to formulate some quite definite rules about scale and scope. A scheme of this kind, requiring international co-operation, is likely to fail if too ambitious a programme be attempted. In appealing to the International Million Map Commission I do not forget that the undertaking is largely an archaeological one; but, while that is perfectly true, the *difficulties* to be overcome are almost entirely cartographic.

It would be premature to discuss details. I will confine myself to two points. The *scale* of the models would naturally be determined by the existence of suitable maps in the country concerned. The scale of 1 : 250,000 is probably the best. The *sources* used could be mainly Ptolemy, the Antonine Itineraries, the Peutinger Tables and the Notitia Dignitatum, with occasional help perhaps from the Ravenna Geographer, from inscriptions and from any special sources available for particular regions. All these have long been accessible in printed

form. New research may be required, and certainly will be required in some countries; but, while this will be all to the good if it can be carried out, it will involve delay, and it is therefore proposed to tackle the easier—or at any rate better-known—countries first. The publication of the first sheet will have a great moral influence upon the success of the whole operation, and I am sure it is important to get one out quickly.

There is just one subsidiary point to be mentioned. In one country, Romania, there are still many gaps to be filled. In particular the course of the Dacian wall or Limes has still to be plotted on a map. Here air-photography would probably assist. The country traversed is flat and suitable for flying, and I would commend the suggestion to those concerned.

The most formidable difficulty to be overcome is that of international co-operation. The national frontiers of the Old World unfortunately do not follow lines of latitude and longitude, as do the sheet-lines of the International Million Map. The unit of *publication* must obviously be a sheet of this map; whereas the unit of *compilation* will have, in the main, to be a national area. This means that, with the exception of one or two sheets, such as L 31 (France) and I 33 (which is not published), international co-operation will be required in producing the models. This will require organization; but to whom could one more aptly appeal than to this Commission?

In outlining roughly the area which it is proposed to cover I have included the *minimum* rather than the *maximum* number of sheets. The frontiers of the Empire fluctuated, especially in the North and East, and it might be desirable later on to add to the number. The present area, however, includes all that is essential, and it can always be increased if necessary. There are in all 48 sheets; of these, 23 are already fully published, and only 3—all unimportant for our purpose—are not in preparation. The work will take some time, and we have enough sheets ready to hand to justify us in making a start. By the time we have completed the 23 published sheets, there will doubtless be others available.

In selecting the sheet to be undertaken first, many factors will have to be taken into account. It is important, as I said, to get something accomplished, in order to show that we mean business, and to set the pace for the rest. The actual decision will of course be made elsewhere; meanwhile, if I may throw out a suggestion, what better sheet could we begin with than that (K 33) now in preparation, containing Rome itself? It includes most of Central and Southern Italy,

extending from Rimini to Taranto, and a small portion of the Dalmatian coast, from Sebenico to Ragusa. The region is very well documented and would present difficulties of exclusion rather than of inclusion. It would be peculiarly fitting that a scheme for a map of the Roman Empire should be launched under the auspices of His Excellency the Head of the Italian Government, who has done so much for archaeology. Furthermore, thanks mainly to His Excellency's personal encouragement, there is at the present moment an unprecedented volume of archaeological activity in Italy.

The scheme is an ambitious one; but the difficulties are practical ones only, and, after all, difficulties exist only to be overcome. The time is ripe; for popular interest in archaeology was never so great as it is now, and it is growing daily. If proof were needed, it might be found in the sales of the map of Roman Britain to which I have already referred. There is no reason why the proposed map should not also ultimately be a profitable undertaking.

A resolution supporting Mr Crawford's suggestions, formally proposed by Brigadier E. M. Jack, and seconded by Sir Charles Close, was carried unanimously. For the text of this see Commission No. 7, p. 48.

20 July

PER UNA COLLEZIONE SISTEMATICA DI RIPRODUZIONI DI CARTE ANTICHE DELLE DIVERSE REGIONI EUROPEE

PROF. ROBERTO ALMAGIÀ

La presente comunicazione può, in certa guisa, considerarsi come un' appendice di quella fatta in una seduta precedente, presentando al Congresso i *Monumenta cartographica Italiae*. Io penso che gli studi di storia della cartografia e della geografia, ed anche gli studi storici in genere, si avvantaggerebbero notevolmente se si potesse arrivare a formare delle Raccolte analoghe per tutti i paesi che hanno una tradizione cartografica assai antica, risalente cioè al principio dell' età moderna. Qualche tentativo esiste già per i paesi dell' Europa Settentrionale e per alcuni di quelli dell' Europa orientale, ma non si hanno finora raccolte sistematiche per le Isole Britanniche, la Francia, la Spagna, la Germania, i Paesi Balcanici ecc. È in corso di pubblicazione una Raccolta monumentale di carte relative all' Egitto; ma sarebbe utile averne anche per altri paesi dell' Africa Settentrionale, per l' Asia Minore, la Siria, la Palestina ed altri territori asiatici.

Nella mia precedente comunicazione io notavo che le carte geografiche costituiscono una categoria di documenti storici finora pochissimo considerati dagli studiosi, e certamente a torto, se si pensi alle preziose indicazioni che esse possono fornire su talune mutazioni fisiche del suolo, sulla situazione di località abitate oggi scomparse e abbandonate, sulle antiche circoscrizioni politiche e amministrative, sui confini ecc.

Certamente è un' impresa non facile, nè breve, ma al contrario laboriosissima, quella di stabilire, per ogni paese, la serie delle carte che sono veramente originali e fondamentali e di distinguerle dalle riproduzioni, imitazioni, contraffazioni più o meno modificate. Per aver sott' occhio contemporaneamente tutto il materiale di comparazione, poichè le carte originali sono spesso di estrema rarità e disperse nei fondi meno esplorati delle Biblioteche e degli Archivi, non c' è altro mezzo che quello di riprodurle in facsimili, coordinando poi questi in raccolte sistematiche.

L' Italia è particolarmente interessata ad iniziative di questo genere, perchè, a partire dalla fine del secolo XV, moltissime carte di diversi paesi d' Europa ed anche di territori extraeuropei, sono state eseguite o almeno stampate in Italia, sopratutto nelle officine di Venezia e di Roma, celebri, durante il Cinquecento, per la produzione di carte.

Per citare solo qualche esempio, accennerò che già nella "Geografia in terza rima" di Francesco Berlinghieri, stampata intorno al 1480, si trovano delle tavole moderne—oltre che dell' Italia—della Francia, della Spagna, della Terrasanta. Qual' è l' origine di queste carte? Se per quella d' Italia a questa domanda si può dar oggi una risposta, per le altre il problema non è ancora risoluto. Tra il 1520 e il 1525 circa, un primo tentativo di atlante di carte moderne si ha per opera del geografo istriano Pietro Coppo; esse accompagnano una sua *Descrizione del mondo*, rimasta inedita; ma di molte carte abbiamo anche esemplari a stampa, rarissimi e non ancora studiati. Più tardi appaiono le carte del Gastaldi, alcune delle quali—specialmente quelle dei paesi europei—attendono di essere illustrate compiutamente.

Io ho avuto occasione di occuparmi un poco di antiche carte della Spagna. Tra quelle stampate a me note, la prima in ordine di tempo è la *Hispania Novella* del Berlinghieri, testè accennata, della quale peraltro si conoscono antecedenti in codici manoscritti. Dopo di questa se ne hanno almeno una dozzina di stampate in Italia nel corso del secolo XVI; tra esse, quella grande e magnifica del Gastaldi, con la data 1544. Appena di qualche anno posteriore è una carta della Spagna eseguita per ordine di Carlo V dal milanese Ludovico Settala;

ma di essa non si conoscono esemplari in Italia. Ne esistono forse in Spagna, dove il Settala dimorò lungamente?

Quello che si è detto per la Spagna si potrebbe ripetere per la Grecia. Quasi tutte le carte relative alla Grecia apparse nel secolo XVI furono pubblicate in Italia. Ma io non voglio moltiplicare gli esempi. Sarei molto lieto se da questo Congresso potesse, in qualche modo, uscire una intesa affinchè i principali paesi europei coordinassero i loro sforzi per preparare raccolte di riproduzioni di carte antiche, analoghe a quelle dei *Monumenta cartographica Italiae*.

M. EMM. DE MARGERIE signale, comme se rattachant au point de vue exposé par M. le Prof. Almagià, l'ouvrage du Dr Rolland sur les cartes anciennes de la Franche-Comté et le recueil de Cartes anciennes relatives au Massif du Mont Blanc, publié par feu Joseph Vallot. A l'autre extrémité de l'échelle, on ne saurait passer sous silence la grande série de cartes anciennes, représentant une notable partie du continent asiatique, que l'illustre explorateur suédois Sven Hedin a reproduit dans son magnifique ouvrage intitulé *Southern Tibet*.

DR MARIE POLACZEK said that Poland at the moment was engaged in the investigation and classification of its ancient maps which are to be found in libraries, official archives or in the hands of private possessors. A provisional catalogue has been drawn up. With regard to the value of ancient maps for information as to the courses of rivers, and the distribution of population she would point out that the very interesting manuscript maps in the *Archives of Chambéry*, 1733–8, edited by Italian cartographers under the orders of King Amedeus, present a condition of things very different from that of to-day.

PROF. RAFAEL DE BUEN signale l'intérêt de la proposition faite par le Prof. Almagià, spécialement pour l'Espagne où la cartographie a eu au moyen âge et pendant le commencement de l'âge moderne une importance très grande. Il conviendrait que, dans le recueil qui serait fait, figurent non seulement les cartes existant dans chaque pays, mais aussi celles sur un pays déterminé existant dans différents pays du monde.

L'année prochaine doit avoir lieu à Séville à partir du 15 mars une exposition internationale d'océanographie, hydrographie et hydrologie dans laquelle on compte présenter une série de cartes anciennes espagnoles. Il serait désirable que les gouvernements anglais, français, italien etc. permettent de disposer des copies des cartes espagnoles les plus intéressantes existant dans leurs archives qui pourraient être exposées avec ce motif, et de publier un catalogue, en imitant ainsi l'idée exposée par le Prof. Almagià.

COMTE PELLATI: Comme le Prof. Almagià a déclaré qu'il y a une dizaine de cartes d'Espagne imprimées en Italie, j'offre, au nom du Ministère de l'Instruction Publique de les faire reproduire en facsimilés par notre *Cabinet photographique* et d'en faire hommage au Gouvernement Espagnol pour le Recueil qu'il est en train de constituer à l'occasion du Congrès Hydrographique de 1929.

A resolution supporting the suggestions of Prof. Almagià, formally proposed by him and seconded by Prof. Emm. de Margerie, was then passed by the Section. For the text of this see Commission No. 8, p. 48.

A UNIQUE ARABIC TRANSLATION OF PTOLEMY'S GEOGRAPHY

HUSSEIN SIRRY BEY

See *Annexes to the Report of the Egyptian Delegates to the Geographical Congress, Cambridge*, 1928, No. 2: *Survey of Egypt*, 1929.

At the request of H.H. Prince Youssouf Kamal, I have great pleasure in presenting to the International Geographical Congress a copy of a manuscript which is an Arabic translation of Ptolemy's Geography.

It was found in June 1927 by H.H. Prince Youssouf Kamal in the library of the Aya Sophia mosque, indexed under the number 2670. It is the only Arabic translation known, but the name of the translator could not be traced. His Highness has also found in the library of the Top Kapu Sarai at Istambul a Greek fifteenth-century manuscript of Ptolemy's Geography bearing the catalogue number 27. The original from which this was copied could not be found. Many pages and plans are missing. The Greek copy closely resembles the Arabic translation; so it seems probable that the Arabic translation was made by the same man who copied the Greek manuscript.

There are three seals on the title-page of the Arabic manuscript. The first and largest bears the monogram of Mahmoud ibn Mostafa surmounted by a text from the Koran.

"Praise be to God who hath guided us hither! We had not been guided had not God guided us!"

The second seal of Nammana Kounad Ahmed "God support him" is in Persian characters. The third seal is supposed to be that of the Sultan Bayezid.

The reproduction has been undertaken by the Survey of Egypt from photographic copies of the original. H.H. Prince Youssouf Kamal does not propose to make a translation of this work but he will present a copy for detailed study and comparison to the Geographical Societies and Institutions to which he has sent his "Monumenta Cartografica Africae et Egyptae."

LA BIBLIOGRAPHIE DE L'ÉGYPTE

Presented by DR W. F. HUME

DR W. F. HUME, in presenting "La Bibliographie de l'Égypte," said that it was begun on the initiative of Prof. Lorin, who submitted a plan which was approved by the Royal Geographical Society of Egypt. The Society had also undertaken to defray the expenses of this work. It is due to the continued munificent support of H.M. King Fuad that the Society had been able to

issue this publication and many others which have lately made their appearance. Those responsible for carrying out the work (Mlle Agrel, MM. Lozach, Hug and Morin) have brought together over 6000 references. An explanation was also given of the general arrangement, and it was stated that a second volume by M. Munier would appear before long.

PROF. ALMAGIÀ remercie Dr Hume pour la présentation de la Bibliographie de l'Égypte et au nom de toute la Section, exprime la plus vive satisfaction pour un ouvrage si remarquable qui est du plus grand intérêt pour tous les savants qui s'occupent à la Géographie de l'Égypte. Cet ouvrage est un nouveau document de la grande activité de la Société Royale de Géographie de l'Égypte, que nous avons déjà admirée et appréciée à l'occasion du Congrès International de Géographie du Caire. Il faut être reconnaissant à la Société et à S.M. le Roi d'Égypte qui a donné un si grand essor à toutes les branches de la science et surtout à la Géographie.

M. EMM. DE MARGERIE fait ressortir la haute importance de la Bibliographie de l'Égypte présentée par le Dr Hume, qui est destinée à remplacer les ouvrages, d'ailleurs précieux, de Jolowicz et de Davies Sherborne. Ce nouvel instrument du travail rendra les plus grands services à tous les géographes, et plus généralement à toutes les personnes s'intéressant au continent africain à un titre quelconque.

TWO SUGGESTIONS FOR THE EARLY HISTORICAL GEOGRAPHY OF ENGLAND

RT HON. SIR HALFORD MACKINDER

Abstract

There are two epochs of history in England for the elucidation of which geography can render much service. They are the transitional epochs from the British to the Roman period, and from the Roman to the Saxon period.

In the British period agricultural settlement was mainly on the uplands, and communication was by paths along the hill ranges or, in other words, by ridgeways. As Roman civilization approached the continental shore opposite, the need arose for new paths and ports on the island in a south-easterly direction. Some years ago, I suggested that London arose at this time as the port of the British tribal capital which is now represented by the city of St Albans. London lay at the end of a ridgeway through Barnet and Highgate. Colchester probably arose in a similar manner. It was as easy for a ship from Boulogne through the then Strait of Wantsum, between Thanet and Kent, to sail to Colchester as to London.

May it not have been that Anderida (Pevensey) had a similar origin? In the *Anglo-Saxon Chronicle* the Weald Forest is called Andredsweald, and there is a well-known entry as to the utter destruction of Anderida by the incoming pirates. Both these facts imply that in the fifth

century Anderida was an important place. At a later time the Conqueror landed there and, advancing along the coast in the direction of Dover, found Harold on his flank on the Battle ridge behind Hastings. Harold had behind him the ridgeway through the Wealden forest to the North Downs and London. There was a relatively easy way from Surrey by the fords of the Thames west of Kingston to St Albans. Tradition has it that Caesar crossed by one of these fords. May not Anderida have risen as a terminal port at the end of this natural way? The road through Kent is not likely to have been a primitive way, because of the numerous river crossings. The Romans more probably first opened it up with their bridges and paved fords (Stratford). In the Middle Ages there were two groups of Cinque ports, those of Kent and those of East Sussex. Of the latter were the "Ancient towns" of Rye and Winchelsea, alternatives to Pevensey at the end of the Wealden Ridgeway.

We know little of the transition from the Romano-British to the Saxon periods. Cannot Geography contribute by suggestions? Consider Oxford. It was almost certainly Ousenford (cf. Osney) and not Oxenford, the Ford of the Ouse or Isis and not the ford for Oxen. Notwithstanding the story of the *Anglo-Saxon Chronicle*, archaeological evidence points to a settlement of the Saxons up the Thames and not overland from Southampton. Ousenford is a hybrid name, Celtic and Saxon. The Saxon boatmen coming up the river would obviously not give the name of the river to any particular ford. On the other hand, the Celtic hillmen along the hill track from North Wilts, through Faringdon and Aylesbury to St Albans, would most certainly frequently refer to the crossing of the Ouse or river, where they might be held up by a flood for days or weeks. Does not the name Oxford imply, under these geographical circumstances, that the Saxon boatmen came into contact with the Celtic hillmen at a place referred to by the Celts as the Ouse? Here the Saxon waterway crossed the Celtic hillway, and a crossing point became a nodal point.

EARLY SPANISH MAPPING OF THE NEW WORLD. THE PADRON REAL

DR E. L. STEVENSON

Abstract

The attempts to map the New World coasts very naturally followed close upon the actual discoveries and the reports concerning them. The references in the literature to very early maps and coast sketches

are numerous, yet practically all of these have disappeared. We however know fairly well the amount and the character of the information they contained. In 1508 there was organized within the Casa a department which we may call the Hydrographic Office with Amerigo Vespucci as Pilot Major and in control of its affairs. The need was felt for the drafting of a Padron Real or Pattern Map and the order issued to Vespucci for the making of the same. It was intended that special importance should be attached to this map. While no authentic copy of this map is known we may find its significant features laid down in one or two extant maps.

By reason of the rapidly increasing number of official and unofficial expeditions of discovery to the New World and the rapid multiplication of records touching the newly discovered regions, and because of the lack of effectual cartographical control, a new Pattern Map was ordered in 1514. No copy of this map is known to exist.

Following on this is an account of:

(i) Some of the prominent early cartographers of the period and their extant work: Morales, Reinel, Ribero, Juan Vespucci.

(ii) The Pattern Map of 1536 by Alonzo de Chaves and what we know of it.

(iii) Some observations on certain features of early Spanish and Portuguese maps and the importance of a study of them from the historian's standpoint.

(iv) The spread of the influence of early Spanish and Portuguese maps into other countries with special reference to certain important but little known early Spanish cartographers and the recent discoveries of their long-lost work.

21 JULY

CLIMATE IN PREHISTORIC GREECE[1]

PROF. J. L. MYRES [*Read by* Prof. O. H. T. Rishbeth]

Abstract

The researches of Ellsworth Huntington on prehistoric changes of climate, supplemented by the work of Antevs, Pettersson, Brooks and others—especially by Gams and Nordhagen in regard to the levels of the Swiss lakes—indicate a prolonged period of cool and moist climate with maxima about 1150 B.C. and 450 B.C., preceded by an

[1] Read at a combined meeting of Sections B and E. For other communications to this meeting see pp. 181–203.

abrupt dry phase before 1200 B.C., and a "high-water catastrophe" rather earlier, interrupting a general shift of climate from the comparatively dry "forestian" phase about 2000 B.C. to the "peat-bog" phase which culminated about 800 B.C.

The present communication makes use of the genealogical traditions of early Greece, and occasional references to droughts and floods in connection with particular generations, to supplement and correct these conclusions from central- and north-west-European data. (1) The colonization-period of historic Greece corresponds with the drier interval between two rain-maxima of 1150 B.C. and 450 B.C. (2) The Alpine rain-maximum commonly dated about 850 B.C. on archaeological comparisons should be brought into connection with the Californian rain-maximum of 1150 B.C., and with the traditional descent of the Dorian invaders from the north-western highlands of peninsular Greece in the generation of 1100 B.C. (3) The invasions of Greece and Asia Minor by horse- and cattle-breeding peoples about 1260 B.C., and the series of "land-raids" and "sea-raids" in the eastern Mediterranean from 1230 to 1190 B.C. result from an abrupt dry phase which is recorded by traditions of famine and drought in that region; and serve to amend the date for the low-water minimum of the Swiss lakes, from about 1000 B.C. to 1200 B.C. (4) The traditional "Flood" in Central Greece, in the generation of Deucalion (1430 B.C.), serves to fix the date of the "high-water catastrophe" of the Swiss lakes, which like other central European dates above mentioned has hitherto been placed too low.

CLIMATIC VARIATIONS IN POLAND, FROM THE END OF THE FIFTEENTH CENTURY TILL THE MIDDLE OF THE SEVENTEENTH CENTURY[1]

DR MARIE POLACZEK

See *Comptes Rendus du* 1^er^ *Congrès des Géographes Slaves, Prague*, 1924 (1926), pp. 90, 91. (In French.)

Abstract

This is the continuation of our former "Les variations climatiques en Pologne depuis le XI^e^ siècle à la fin du XV^e^ siècle" based on the history of Jean Długosz ("Longinus") and of mediaeval historic monuments.

The aim of that and of similar studies is to ascertain the variations

[1] Read at a combined meeting of Sections B and E.

of climate which lie beneath the rich and varied data yielded by historic materials, and to solve the problem as to how far these climatic variations exercised any influence especially upon human life and upon rural economy. These influences were so pronounced as to draw general attention to the approximate periodicity of the phenomenon as well as to the simple or multiple character of its manifestation. Thanks to the devoted collaboration of M. L. Grzędzielski, Mlle H. Jarocka, M. V. Przepiórski of the University of Lwów, we have obtained ample material within the space of a few months. More than 200 historic sources—about 1000 volumes—have been consulted. It is to be hoped that no printed document of any value, in Polish, has been passed over. We have even been able in some measure to extend our studies into neighbouring countries and intend to carry this extension further.

Our starting point was the period 1471–1474/5, remarkable over the whole of Europe for its dry and cold winters, and its catastrophic summer droughts. In Poland the maximum effect was felt in 1473.

The classification adopted was as follows:

For the minima:

(*a*) Intensely cold winters and late springs.

(*b*) Cold and wet summers and early autumns.

For the maxima:

(*a*) Mild dry winters and early springs.

(*b*) Warm dry summers and late autumns.

We must also include mixed periods with snowy but not intensely cold winters, very variable springtime, summers fairly warm but rainy, and autumns with vicissitudes of warmth and cold.

In historical records cold winters are marked by frosts and early freezing of rivers, by late and catastrophic spring spates, by migrations of wolves attacking men and their belongings. Effects upon military operations are noted by historians dealing with this branch of the subject. Summer spates, crops destroyed by sharp showers with violent winds, mark the minimum. For our region winter rains, winter storms accompanied by thunder and lightning, sudden and rapid thaws are evidence of winters milder than the normal, winters which present no obstacles to military operations. A warm summer is betrayed—apart from direct remarks about the heat—by early harvests, by town and forest fires especially, by the drying up of springs, by easier fords, which incidentally facilitate the passages of hosts of field-crickets or of grass-hoppers across the country. Plagues of mice attest a dry autumn.

Among hypothetical notions which have indirectly helped to furnish evidence of drought may be noted the idea that famines were caused by the appearance of comets. In the "Kurtze aber trewhertzige Erklerung des geschwänzten newen Sterns oder Cometen" by Helizius v. Zeitz (Lübeck, 1609) comets are definitely linked with a diminution of raininess, and contrary cases are noted, *e.g.* "in spite of the appearance of a comet, the harvest has not failed." The profusion of historic materials sensibly on the increase during the sixteenth century permits a regional classification of climatic ideas. Such classification appears to us to be necessary in order to avoid attributing a general bearing to some fact, such as a hail-storm, of purely local significance; but this regionality threatens our data to some extent with a scattering into a number of climato-historic regions with accidental characteristics. This threat, however, arising out of merely negative evidence, tends to be dissipated with the advance of research in neighbouring regions. On the other hand there are cases where for the same region we are faced with data diametrically opposed to one another! This is sometimes due to an error of dates on the part of the writer, sometimes to over-eagerness to generalize a transitory phenomenon.

It must be remembered that the periods of climatic variation which we try to disentangle are always only an attempt, a plan of construction which the human mind introduces into phenomena to comprehend them in their variability.

We can sum up our rather scanty results to date as follows:

(1) Historical documents giving irrefutable proof of climatic variations, plus or minus to the normal, or rather to the annual mean variation to which the organized beings of the locality in question are accustomed.

(2) During any given period—since the processes of nature are gradual—there are to be found the fading traces of variation-periods of every length. The study of historic climates may then be able to fill in to some extent the gap between the study of geologic climates—especially those of quaternary time—and that of present-day meteorology.

(3) Our previous observation that, according to the historic data, rigorous winters generally follow cold and rainy summers, cannot be wholly maintained. For Silesia, our region most rich in data, there is indeed a large proportion—as much perhaps as 30 per cent.—of contrary observations, where a cold winter precedes a rainy spring and summer with perceptibly lower temperatures.

(4) As to climatic variations, the best observed by the historians are the extremes, *sc.*, either the maxima or the minima. This is found to be true beyond the borders of Poland. From the Rhine throughout Europe to the plateau of the Upper Volga in North-west Russia, general attention is always rather drawn to the minima, viz., excess of cold and precipitation, rather than to the maxima, of heat and drought. Complaint is made against the former as not merely causing floods, but also harvest failure and famine. Thus for Silesia we have a striking relation. Of 86 precise indications 54 (*i.e.* 63 per cent.) refer to a lowered temperature or excessive precipitation, leaving a much smaller percentage of reference to improvement in the climate. No region of historic Poland, not even Podolia nor the Ukraine, yields an exception to this rule. It is only in Walachia and Moldavia, *i.e.* in the steppe region of the Black Sea, that we find an inverse relation, neither so decisive in its proportions (46 : 54), nor so convincing from the number of indications on which it is based—39 only in 150 years. In any case the leaning of the balance towards heat and dryness as more important for mention reflects the climatic interests of a different natural region.

We seem to see here a trait characteristic of all Europe: how much—thanks to the influence of the Atlantic Ocean, penetrating far into the heart of our continent—European continentalism, in its relativity and moderation, differs from that of the Asiatic block, since these climatic minima, according to the chroniclers, affect catastrophically economic and agricultural life. If after a period of minimum the chroniclers keep silence about meteorological phenomena, it is sound to consider this as witnessing a return to normal conditions of temperature and precipitation or as "plus" in a climatic sense. It follows that bad harvests and dearths are connected for the most part in our region with periods of cold and damp. An odd result which seems to emerge is that there are years in which the downright maxima and minima appear to approach one another in time and space. It appears certain that there are periods in which Europe from the banks of the Rhine to the borders of western Russia undergoes a great variation, a climatic maximum or minimum. But between these are other years or periods, in which the different parts of Europe are under the influence of opposed variations, or at least the same variations with different degrees of intensity. The problem is a difficult one, but of importance for science, and demands persistent attention.

23 July

LES CARTES GÉOGRAPHIQUES ET L'HISTOIRE

SIR GEORGE FORDHAM

See *Note sur la Liaison entre la Cartobibliographie et l'Histoire: Bull. Soc. Royale Belge de Géographie*, No. 1, 1923.

Au Congrès de Bruxelles de 1923—Cinquième Congrès International des Sciences Historiques—j'ai offert une communication insignifiante intitulée: "Note sur la liaison entre la Cartobibliographie et l'Histoire," et je me permets aujourd'hui de broder sur un thème analogue. C'est-à-dire que je me suis proposé d'approcher ce sujet d'un côté plus objectif.

Dans les études que j'ai poursuivies, à ma manière, pendant une trentaine d'années déjà, j'ai examiné une grande quantité de cartes provinciales, comtales, et autres, qui se basent sur les détails locaux et particuliers, et qui enregistrent ainsi une masse de faits divers de l'histoire intime des habitants des pays, plus particulièrement de ceux de l'Europe centrale. D'autre part on est frappé de l'importance des détails semblables et d'autres encore, qui se trouvent, pour ainsi dire, fixés sur les cartes-routières qui, depuis au moins quatre cents ans, existent en Europe, et avec les guides-routiers eux-mêmes constituent, dans l'ensemble, une matière précieuse pour l'histoire intime du peuple et des nations.

Cette histoire intime du peuple se trouve naturellement illustrée de divers côtés dans leurs mouvements journaliers, dans leurs voyages, et, en parcourant les guides et les itinéraires, depuis ceux ébauchés vers la fin même du quinzième siècle pour les pèlerinages en Terre Sainte, à Rome, à Lorette, à Saint Jacques de Compostelle, et ailleurs, jusqu'au moment où toute cette mécanique du voyage sur la route carrossable se trouva paralysée par l'apparition du chemin de fer, on arrive à des connaissances historiques et géographiques très détaillées et très intéressantes. On dira peut-être que c'est de l'histoire pure, mais à mon idée la géographie y trouve aussi une grande place et, en tout cas, la cartographie, science sœur de la géographie y joue un rôle très important. Une liaison s'établit ainsi entre ces trois sciences. J'ai tâché d'établir la bibliographie des guides et itinéraires de l'Europe centrale en commençant avec celles des Îles Britanniques et de la France, et en même temps, la cartobibliographie qui s'associe à cette bibliographie proprement dite, et, si je me permets d'attirer l'attention du Congrès sur cette matière maintenant mise au service du monde scientifique, c'est seulement "pour mémoire."

Les premières cartes de routes gravées existaient déjà à la fin du quinzième siècle et de cette même époque on connaît les récits de voyage en Terre Sainte de Breydenbach et d'autres pèlerins. On trouve en Angleterre, dès l'an 1541, de petites tables imprimées des étapes des neuf routes postales du royaume et de la principauté du Pays de Galles, qui toutes, sauf celle d'Écosse et celle aussi du pèlerinage important à Ste Marie de Walsingham sur les côtes du comté de Norfolk, sont des voies de communication entre la métropole et les ports de mer. Bien entendu, à cette époque, il n'existait pas de centres industriels sauf sur le littoral. C'est probablement dans ces petites tables que l'on doit reconnaître le commencement de cette espèce de littérature qui, depuis, est devenue une masse bibliographique assez considérable et très variée.

Cependant, il faut chercher à Paris les premiers guides des voyageurs, ceux de Charles Estienne, publiés dans une longue série d'impressions pendant presque un siècle, et dont les deux éditions premières sont toutes les deux de l'an 1552. Un guide dans le même genre, avec l'adjonction de Listes des Foires de l'Europe et de Tables des Monnaies, est celui de Théodore de Mayerne-Turquet, la "Sommaire Description de la France, Allemagne, Italie et Espagne" (Genève, 1591). De celui-ci aussi les éditions sont nombreuses. Naturellement, dans ces petits livres à l'usage des voyageurs, pèlerins, marchands et autres, les détails ne sont pas très développés, mais, quand même, ils ont de l'intérêt historique et géographique, et quand on ajoute les Listes des Foires et les Tables des Monnaies et des Changes l'intérêt augmente peu à peu. Les distances à parcourir sur les routes et entre les endroits où se trouvaient les postes aux chevaux, d'abord entachées de vague, se précisèrent petit à petit jusqu'au moment où en France les "Listes Générales des Postes de France" commencèrent à paraître aux premières années du dix-huitième siècle (1708)—commencèrent enfin une existence qui se termina seulement vers le milieu du siècle suivant.

C'est un peu plus tôt que John Ogilby mesura, pour le compte de l'administration postale, les routes de l'Angleterre et du Pays de Galles, les résultats de ces arpentages paraissant en 1675 dans un volume in-folio de cartes de routes dessinées en bandes. A ce moment seulement reconnut-on la grande différence entre le vieux mille britannique, l'équivalent de l'ancienne lieue gauloise (leuga gallica), qui survécut tous les changements des siècles, toutes les invasions—romaines, saxonnes, normandes—et dura dans les mœurs anglaises jusqu'au milieu du dix-septième siècle, et les milles, fixés d'après la

loi actuelle. Cette différence des mesures a, il va sans dire, une importance sensible pour l'historien. Traduite en mètres elle est de 2200, contre 1609.

Dès la publication de la *Britannia* d'Ogilby les guides-routiers et surtout les cartes-routières "à la manière anglaise," comme on disait plus tard, pullulaient en Angleterre, tandis qu'en France la chose se développait d'un autre côté par les travaux immenses des ingénieurs et dessinateurs de l'organisation connue de nos jours sous le titre "Ponts et Chaussées." Ces travaux de réparation, ou plutôt de reconstruction des routes royales de France, basés sur l'application à toute la population rurale du royaume de la tyrannie oppressive de la corvée royale des routes, se poursuivirent avec vigueur pendant plus d'une trentaine d'années entre 1740 et 1770 environ, se ralentissant enfin en conséquence des difficultés inhérentes à la concentration des efforts de la totalité de la main d'œuvre sur les travaux des routes, et le manque d'argent dans le trésor royal. Pour les géographes, et tout spécialement pour les cartographes, l'importance de ces travaux se voit dans la série remarquable de cartes des routes de France, qui en résulta, et dont une partie seulement, restes de ce travail cartographique de toute beauté, est encore conservée aux Archives Nationales à Paris.

Parallèlement à ces travaux spéciaux la triangulation de la France et la publication des feuilles de la grande carte du royaume des Cassini se faisaient—beau monument cartographique et technique du génie français—et la carte immense des Pays-Bas autrichiens du Comte de Ferraris s'ajoutait aux richesses cartographiques du monde. Cette dernière carte, sur une échelle huit fois plus grande que celle de la France, faite et peinte à la main, établie en 275 feuilles, est à mon avis de beaucoup la plus remarquable entreprise cartographique du dix-huitième siècle et peut-être de tous les temps. Elle a devancé de plus de cent ans le mouvement de nos jours pour pousser à des études régionales, cartographiques, topographiques et descriptives. Car, ce qui ne se trouve nulle part ailleurs, paraît-il, s'associe avec cette carte, c'est-à-dire une description détaillée du pays, de ses institutions, de sa condition, dans tous les domaines, écrite en mémoires spéciaux pour chacune des 275 feuilles, et qui existe encore en plus de 4000 pages manuscrites, ce qui, avec les cartes à l'appui, constitue un trésor d'information historique et économique extrêmement précieux. Par comparaison, ce que nous tâchons de faire aujourd'hui sous la rubrique *Regional Survey* ne paraît que fragmentaire et faible.

Quoique la carte elle-même de Ferraris n'ait jamais été gravée, une

réduction assez magnifique a été faite et publiée en 1777. Cette réduction gravée est établie sur la même échelle que celle de la grande carte de France des Cassini. La question de la route—la route, la base primitive de la cartographie—ne doit pas être ignorée de la géographie, surtout dans ses relations avec l'étude de l'histoire de la cartographie. Je me permets de plaider dans ce congrès mondial pour l'admission des études de ce sujet parmi celles reconnues comme faisant partie de la science géographique. La liaison entre la géographie, la cartographie et l'histoire s'établit de diverses manières.

L'importance des cartes existantes à des moments donnés pour les études des événements survenus à ces mêmes époques n'est pas douteuse, mais les cartes géographiques laissent souvent beaucoup à désirer, et souvent aussi au sujet de leurs dates sont très sujettes à caution. Pour leur étude l'historien doit s'appuyer sur les carto-bibliographes et sur les géographes qui en ont fait le sujet de recherches scientifiques et historiques. Les dates des cartes de tous les temps, sauf celles des cartes tout à fait modernes, faites sur l'ordre des gouvernements, où l'exactitude s'est imposée, sont à examiner avec soin. Il est facile de citer des exemples presque extraordinaires. Une carte de l'Angleterre et du Pays de Galles, en vingt feuilles, sur une échelle assez grande pour cette époque, faite par Christopher Saxton vers 1584, fut copiée très exactement par le célèbre graveur Hollar, et publiée par un certain Thomas Jenner, soixante ans plus tard, à l'usage des deux armées du Roi et du Parlement en 1644. Re-publiée en 1671 par Jenner, avec l'adjonction des routes principales du Royaume et de la Principauté, et, en 1687, par un autre éditeur, John Garrett, et encore une fois, en 1752, par John Rocque, on vient d'en découvrir un exemplaire imprimé sur papier portant la date en filigrane de 1799! L'existence donc pour ce dessin cartographique s'étend sur plus de deux cents ans. L'historien qui fait baser l'étude des faits historiques sur un de ces divers exemplaires d'une représentation de la surface et des détails géographiques de la fin du seizième siècle en les attribuant à une période de beaucoup postérieure à celle du géographe Saxton pourrait bien se tromper étrangement! Je pourrais citer d'autres exemples même d'aujourd'hui surtout dans ce que l'on peut classer comme cartographie commerciale à bon marché.

Une autre question quasi-géographique ayant rapport à des études historiques est celle des communications établies sur les routes postales et autres à diverses époques. S'il s'agit de fixer le temps nécessaire à parcourir une distance telle que celle entre Rome et

Paris, soit en se servant du courrier postal, soit en courant la poste à franc étrier, soit par courriers spéciaux, il faut pour cela consulter et compulser les guides, les itinéraires et les règlements postaux qui s'y trouvent. On peut citer par exemple les règlements pour la transmission du paquet postal en Angleterre, de la fin du seizième siècle, très précis pour le mouvement régulier et sans arrêt des dépêches du gouvernement, et même pour les lettres ordinaires confiées à la poste royale. En outre, pour l'étude des mœurs et de la vie ordinaire et intime d'un peuple—étude géographique en partie du moins—les guides-routiers et les cartes-routières sont, sans aucun doute, d'une utilité considérable. Je tiens à mettre ces petites illustrations en avant, à l'appui de ma thèse, qui sera, je l'espère, reçue par le Congrès comme présentant un intérêt bon à rappeler et à préciser de temps à autre.

M. CH. DE LA RONCIÈRE rappelle les beaux travaux de Sir George Fordham sur les itinéraires postiers de la France et de la Grande-Bretagne. Il n'y a rien à ajouter à sa bibliographie. Mais il commence au XV^e siècle. N'y aurait-il pas bien d'étudier les itinéraires du Moyen Age, qui ont fait suite aux itinéraires romains, Carte de Peutinger, Itinéraire d'Antonin, etc.? Ils ont été la base de la cartographie médiévale. On pourrait en proposer l'étude pour le prochain Congrès.

SUR LA NÉCESSITÉ DES ÉTUDES DE GÉOGRAPHIE PRÉHISTORIQUE

S. KOMAKI

Résumé

La géographie est la science par laquelle on recherche les relations de la nature et de l'homme.

Dans la géographie physique on recherche les phénomènes et les conditions de la nature, considérant celle-ci comme milieu de l'homme.

Dans la géographie humaine on étudie les relations entre la nature et l'homme, en mettant le centre de gravité des études du côté de l'homme; c'est-à-dire les relations de l'influence de la nature sur l'homme, et de l'action de l'homme sur la nature; en somme, les rapports de l'adaptation et la conquête humaines.

Mais, dans les recherches géographiques, nous ne pouvons nous contenter d'une simple étude qui ne serait pas fondée sur des bases historiques. D'où la nécessité de l'étude de la géographie historique.

Dans cette branche on rechercherait: quelles étaient les conditions naturelles à l'époque historique (côté physique de la géographie historique); quels ont été les changements de conditions physiques

provoqués par les forces naturelles (côté physique); quels ont été les changements de conditions physiques provoqués par les forces humaines (côté physique, en considérant les hommes comme éléments de la nature); quelle a été l'influence des conditions physiques sur l'action, l'activité et la vie humaines, c'est-à-dire de quelle manière l'homme s'est trouvé influencé par la nature et comment il s'est adapté aux conditions naturelles (côté humain); quelle a été la part d'influence de l'homme sur la nature, quels ont été les changements de conditions physiques autour de l'homme, changements produits par l'action et l'activité humaines, c'est-à-dire jusqu'à quel degré l'homme a pu conquérir la nature (côté humain).

Donc nous pourrions dire que la géographie historique est une branche de la géographie, par laquelle nous étudions les relations des conditions naturelles qui ont subi, avec le courant du temps, une certaine transformation par les forces naturelles et humaines, et du développement de la civilisation humaine pendant l'époque historique.

Mais nous ne pouvons nous contenter d'une simple étude de la géographie historique. Nous devons remonter un peu plus haut dans l'échelle de la civilisation, parce qu'en effet l'homme apparut avant l'histoire. D'où la nécessité des études de géographie préhistorique.

Et de plus, comme les conditions naturelles de l'époque préhistorique étaient différentes de celles de l'époque historique (par exemple la topographie, le climat, la faune, la flore etc.) et comme les hommes néolithiques et fossiles étaient aussi différents physiquement et intellectuellement, l'étude des rapports entre les conditions naturelles et les hommes des époques préhistoriques (leur jonction avec les époques historiques est naturellement différente suivant les différents pays) est non seulement nécessaire mais aussi peut présenter un assez grand intérêt.

M. LE PROF. DEFFONTAINES fait remarquer que les études de géographie préhistorique sont commencées depuis déjà longtemps, que personne ne doute de leur utilité. Il serait surtout utile de trouver un collaborateur pour chaque pays. Le Japon n'étant pas représenté à la commission de l'Atlas préhistorique, il serait désirable qu'un géographe préhistorien de ce pays veuille bien apporter son concours.

IL LAVORO ARCHEOLOGICO DELL' ITALIA A RODI E NEL DODECANESO

GR. UFF. CONTE F. PELLATI

Non spiacerà ai membri del Congresso geografico internazionale apprendere ciò che l' Italia ha compiuto in quindici anni di ricerche e di lavori per estendere le nostre conoscenze sulla topografia storia di Rodi e delle isole minori del Dodecaneso e per scoprirne, valorizzarne, conservarne le antiche vestigia monumentali.

Lo studio della storia e delle antichità di Rodi prima del 1912 si può riassumere negli scavi del Biliotti e del Salzmann alle necropoli di Camiro e di Jaliso, in quelli del Herzog all' Asklepieion di Coo e in quelli della Società delle Scienze danese sull' Acropoli di Lindo, oltre alcune sillogi epigrafiche e alcune descrizioni di carattere topografico e architettonico.

Ma molti punti della storia e della topografia di Rodi e delle altre isole, nonchè delle forme di civiltà in esse successivamente svoltesi, erano rimasti nell' ombra e la maggior parte dei suoi monumenti richiedevano cure pronte e radicali. A questa vasta impresa si è accinta l' Italia sin dal 1912.

Una prima ricognizione, compiuta subito dal Gerola, ha permesso di costituire un esatto e completo inventario dei suoi resti archeologici e dei suoi edifici d' interesse storico o artistico. E, senza indugio, l' opera di ricerca e di restauro è cominciata, col potente sussidio di quattro organismi, di mano in mano costituitisi nell' isola; la Missione archeologica, il Museo di antichità, il periodico "Clara Rhodos" e l' Istituto Storico Archeologico di Rodi. La Missione, che già dal 1914 ha regolarmente funzionato, ha compiuto sopratutto i grandi scavi dell' Acropoli e delle vaste necropoli di Jaliso. L' esplorazione di Jaliso, infatti, all' infuori della necropoli micenea parzialmente esplorata dal Biliotti e del Salzmann, è interamente opera della Missione italiana; ad essa si deve il metodico completamento della esplorazione di quella necropoli micenea; le nuove ricerche in quelle dei periodi successivi dall' età geometrica all' età classica, e particolarmente in quella arcaica; la riesumazione dei resti del Tempio di Athena Jalisia e di una interessante fontana architettonica del IV^{e} secolo. E da queste indagini largamente si accrebbero le nostre conoscenze sulla evoluzione delle varie civiltà dell' isola, da quella micenea a quella classica. La Missione ha condotti inoltre saggi numerosi sull' Acramiti, a Lindo, a Camiro, a Villanova, al Santuario

di Zeus Atabirio, a Coo e nelle grotte preistoriche di Calino. I materiali raccolti venivano di mano in mano sistematicamente riordinati nel grande Museo archeologico che, sorto sino dal 1914 nel magnifico e ripristinato Ospedale dei Cavalieri e di anno in anno accresciuto e sempre più metodicamente riordinato, occupa oggi un posto cospicuo fra le pubbliche raccolte del Levante. Entro la sua grandiosa cornice esso offre ormai una visione sintetica e perfettamente delineata di quello che fu lo svolgersi delle civiltà rodie attraverso diecine di secoli, dai resti frammentari delle età primitive sino alle forme d' arte e di tecnica che rispecchiano e rivelano i caratteri rappresentativi dell' etnografica locale. E già esso accoglie anche una discreta raccolta di opere dell' antica plastica greca, che, di mano in mano integrata da nuovi trovamenti, non poco gioverà alla conoscenza di quello che fu la statuaria rodia del II e I sec. av. Cr. La Missione ha anche data la sua opera al restauro dei monumenti, e i templi di Rodi, di Lindo e di Jaliso, le fortificazioni greche, gli acquedotti, le tombe rupestri di Rodi, i castelli e i palazzi cavallereschi di Rodi, di Coo e di Lindo hanno ritrovato il loro decoroso e sicuro assetto. La topografia storica di Rodi e del suo suburbio, infine, veniva con dati rigorosi stabilita e confermata. Gli altri due organi sono di data più recente: rimontano a quest' anno medesimo e si debbono all' azione personale, vigorosa e geniale del Governatore Mario Lago. L' uno di essi è una grandiosa Pubblicazione periodica, che porta il titolo "Clara Rhodos" e fa seguito per il Dodecaneso all' Annuario della Scuola di Atene e delle missioni italiane in Oriente. Già è uscito il primo volume, contenente un quadro di sintesi dell' opera di esplorazione compiuta negli ultimi tre lustri, e presto seguirà il secondo; tutto ciò che si va compiendo nel campo archeologico, storico e artistico a Rodi e nelle isole minori troverà in questi magnifici volumi una illustrazione adeguata e rigorosamente precisa e sicura. L' Istituto storico archeologico di Rodi, col quale S. E. Lago ha inteso coronare questo trilustre lavoro e che fu inaugurato il 12 maggio in occasione del Convegno archeologico internazionale, è destinato a diventare un fervido centro di studi per tutti coloro che daranno la loro opera a risuscitare le antiche memorie, a chiarire la topografia storica, dell' Oriente ellenico e dell' Oriente latina, e ad illustrare i superstiti resti archeologici o artistici, storici o etnografici che si trovano nelle isole dell' Egeo o sulle coste dell' Asia anteriore.

DESCRIPTION OF UNIQUE PTOLEMAIC WORLD MAP

HUSSEIN SIRRY BEY

See *Annexes to the Report of the Egyptian Delegates to the Geographical Congress, Cambridge*, 1928, No. 3: *Survey of Egypt*, 1929.

Abstract

H.H. Prince Youssouf Kamal has sent to the Congress a reproduction of a unique world-map in his possession. The original was purchased from Dr F. C. Wieder at Leiden two years ago, and is now in the Royal Library at Cairo. It is a Ptolemy world-map drawn and printed in Italy. It differs from the world-maps in Da Lapis's Bologna (1477) and Buckrick's Roma (1478) editions and also from the Berlinghieri Florence editions of 1478–1481. Thus we have here an Italian Ptolemy world-map different from all known maps. It seems possible that this is one of those which Taddeo Crivelli contracted to make in 1474, and that it thus antedates his map in the Bologna Atlas by three years. We have here in that case the earliest known printed copy of a Ptolemy world-map. I would like to point out that the map has a framework of its own—a fact that makes it probable that it was issued separately and not in an atlas. The reproduction exhibited is of the same size as the original. H.H. Prince Youssouf Kamal would be very pleased if the experts attending the Congress would examine the map with a view to arriving at definite conclusions.

DR STEVENSON said he was sure that this Ptolemy world-map would prove to be of great interest as an example of early map making and map engraving, comparable in importance with the recently discovered Contarini map, now in the British Museum.

24 JULY

REAL AND IMAGINARY GEOGRAPHICAL CONDITIONS AS DETERMINING FACTORS IN EARLY DISCOVERY AND EXPLORATION

DR E. L. STEVENSON

It may seem quite unnecessary to stress here the fact that an important and intimate relationship has always existed between the varied activities of peoples or nations, which, generally speaking, we may call their civilization, and the physical environment which has

surrounded them, *i.e.* that there is a relationship existing between geography and history.

Herodotus, the so-called father of history, noted the importance of a consideration of such relationship, should one wish to have an accurate story of the race. It is a regrettable fact that all too many of those who have laboured within his field or branch of study have overlooked this relationship, have neglected to give it at least some consideration, or have measurably failed in their interpretation; hence the importance of repeatedly stressing it.

It is but a narrow view which would seek to emphasize the thought that physical environment has been the sole determining factor in the existing sum total of man's political, social, economic and religious status in any stage of his history. The historian and the geographer, happily to the credit of each, are finding that there is a real relationship they can encourage and cultivate, to their mutual advantage.

It is not the intent of this paper to attempt a summary of the real and the imaginary geographical conditions which may have been determining factors in the successive stages of expanding geographical knowledge through the long centuries, but rather to give a very brief consideration to them as a directing influence in the expansion of knowledge during the period generally regarded as that of great geographical discovery.

This period opens with many traditions inherited from antiquity and from the Middle Ages, more or less generally accepted as truth. Some of these, in their origin, were based upon the best scientific observations of the day, some of them were altogether unscientific and but little more than visionary interpretations of geography as it was thought it should be; witness here the monastic geography and its interpretation or representation in the maps.

By no means was the best geographical knowledge of antiquity wholly overlooked in the Middle Ages; by no means was there an utter failure to give fairly accurate interpretation to the real geographical conditions of the day, nor a total lack of interest in them.

Of the earliest traditions or theories, which we may count the most significant, many of which lingered well on into the period of our great geographical discoveries, were those respecting the shape and the size of the earth. Some held that it was globular, some that it was circular and flat, being surrounded by the ocean stream, beyond which, or in the very remotest regions, *i.e.* in the outskirts of the Oikoumenē, were races closely or distinctly resembling known races—"Antipodal peoples," as they were called by Aristotle who believed

in a spherical earth, or "Marvelous and Monstrous races," as they were called and described by Solinus.

Few, if any, of the maps of the very early centuries, in which there may have been set down the best geographical knowledge, were preserved to exert an influence on plans which may have been entertained in Roman or post-Roman Imperial days for further geographical discovery. Theories there were, philosophical theories or interpretations; herein were the best contributions of the ancient Greeks for example.

The best maps out of the early centuries are the Ptolemy Maps—if indeed he made them—that is, the originals of those we now call Ptolemy Maps. These set certain limits and bounds to the Oikoumenē, making, for instance, the Indian Ocean an enclosed sea. How widely this was believed in his day, or for centuries thereafter, we need not here discuss, but, accepted as a geographical fact, it answered in the negative the question concerning the possibility of circumnavigating Africa to reach the Indies of the East.

It is interesting to note, for example, the interpretation of the map-makers in the centuries following Ptolemy's day, that is, following the second century of the Christian era, as to the existence of a waterway by which one could pass from the shores of the West to the shores of the extreme East; interesting also to note how this imaginary geographical condition determined and directed the course of contact between those widely separated regions of the earth; how this imaginary condition gradually yielded to an increasing knowledge of the real geographical conditions. Here one is led into a consideration of the part played by the early Italians and the Portuguese, into a consideration of the beginnings of discovery by ocean routes, and how movements over these routes were affected by lingering traditions and by the rapidly increasing knowledge of the real geographical facts. Something of what the map records tell us I am about to present.

Since Europe was now beginning to face westward rather than eastward for its geographical adventures, let us turn for a little to the real and the imaginary conditions as operating in the early years of trans-oceanic discovery and exploration, and first of all as to some of the reasons why trans-oceanic navigation was delayed.

To venture on such an enterprise, particularly if that should carry the sailor beyond the sight of known coasts, called for daring in the extreme. The cities of Italy were the first to place their seamen in training for such an undertaking. They came early to know the Mediterranean and the conditions for navigating it. They charted its waters and coasts; and when their knowledge of seamanship

encouraged them to yet greater daring, there was the ocean beyond the Pillars of Hercules inviting them, with its mysteries and possibilities for successful venture.

As early as 1291 a Genoese expedition seems to have reached a point well down the north-west coast of Africa. This was the beginning of a long series of such enterprises which soon led to the re-discovery of the Canary Islands, the Fortunate Islands of the ancients, to the discovery of the Madeira Group and to others off the coast of Africa and in the waters of the eastern Atlantic.

In these ventures to southward along the African coast, it was soon learned that vessels were needed of a different type from those employed, for instance, in the coasting Mediterranean trade. How to tack against an adverse wind was an early and a perplexing problem, especially for those who sailed out into the Atlantic. If carried away from familiar coasts by an ocean-setting breeze, how was a vessel to return in the face of an opposing wind? Here was a problem in seamanship which had first to be met and solved, in part at least, before the navigator could feel himself safe in venturing far into unknown waters. Trans-oceanic discovery, we may therefore say, waited more for ships and instruments of navigation than it did for daring sailors. It needed but the hardy Italian and Portuguese seamen to dispel the lingering mediaeval tales, and to show that the real geographical conditions favoured exploration westward as well as southward. It is time to eliminate from our histories the statement that it was a belief in existing terrors of the deep that most hindered ocean navigation. Stories of monsters, of impassable fiery zones, were cloister-born and not the creations of easily frightened seamen.

One cannot here entirely omit a reference to that most significant factor in opening the new period of trans-oceanic discovery and exploration—Prince Henry the Navigator. He was moved to the enterprise which gives him so important a place, not so much by a desire, if at all, to reach the Indies of the East by circumnavigating Africa, as by a desire to plant trading posts southward along the African coast, spread the Christian faith into those regions, and to seek to establish a connection with Prester John, who, it was thought, ruled in the third India, that is, in the India of East Africa.

Whatever the part of Prince Henry the Navigator in the expansion of geographical knowledge, this should never be lost to sight by those who turn to a consideration of the initial steps in the opening of a way to the New World. I have referred to the need of better ships than were those which sailed the Mediterranean, to the need of instruments

of navigation, such as the compass and the astrolabe, before there was overmuch inclination to venture directly westward into the Atlantic. It is quite certain that the discovery of the New World would have been long delayed had it waited for an explorer bold enough to venture on a *direct* course westward from England, from France, or from Portugal.

I should not want to insist in a belief that Columbus was especially encouraged in his enterprise—which was rather to find "Islands and Mainlands" in the Ocean Sea than to seek for a waterway westward to the Indies of the East—by a possible knowledge of westward moving trade winds and ocean currents off the coast of Africa; yet we know that he set his sails, on leaving Palos, for the Cape Verde Islands as a real starting-point in his venture for new discoveries. Whether we accept the story of the unknown pilot's discoveries far away to the west—a story generally accepted by early Spanish writers—or the Pinzon story of a purpose to search for the Island of Japan, we know he went in search of what he thought to be Islands and Mainlands farther westward than were those then known, *i.e.* than the Cape Verde Islands, the Canaries, Madeira and the Azores. It was but natural that the discovery or re-discovery of these Atlantic Islands should lead to the belief that yet others might be found. If unknown lands were discovered to southward, why might they not be discovered to westward?

If the better ship, the compass, the astrolabe were necessary for successful westward sailing into the Atlantic, there were also the charts of the day—Portolan Charts or Sailors' Charts—which served both to inspire and to direct. Of the geographical records of earlier centuries which have come down to us, none are more interesting than these Portolan Charts or Cartae Nauticae[1]. To the cloister maps of the Middle Ages they present a notable contrast. The former strikingly exhibit the influence of ecclesiastical and classical tradition. Portolan Charts were the creation of seamen, navigators, explorers, who were the real leaders in the expansion of geographical knowledge which opened the new-world regions of Africa, of India, and of America. If the idea of an all-encircling ocean, as the map-maker set it down, might have lent encouragement to a belief that India could be reached from Spain or Portugal by an all-water route, the idea of the existence of islands or continents well to the west in the Atlantic was encouraged by the Portolan Chart maker. Lingering tradition told of Atlantis, of

[1] The use of the single word "Portolan" for a *map* is erroneous. "Portolani" were Harbour *Books* or Coast "Pilots."

the Fortunate Islands, of St Brandan's Island, the Island of the Seven Cities, Antilia, Brazil, Satanaxa, the Island of Man, and on many of the Portolan Charts some or all of these were set down. Sometimes they appear as floating islands, being located by one chart-maker in one part of the Atlantic, by another chart-maker in another part. Their habit in this respect we often find paralleled by the chart-makers who attempted to give information concerning the New World. What rumour related that they often entered as fact; that for which search was made was often set down as actually existing. To some of the records of these Portolan Charts, truthful or imaginary in their origin, I shall presently call special attention. Not the least interesting of these records is the location of the Island of Antilia, which it is increasingly believed Columbus went out especially to find.

After the ocean had been crossed and Columbus had made his landing, speculation immediately began as to exactly what had been found. There is scarcely a question more interesting in the history of New World discovery and exploration than that which here arises, involving the interpretation of what was actually found, and the consideration of the real geographical facts as directing that interpretation and the course of subsequent discovery and exploration.

There is danger of being carried quite too far afield by any attempt at a detailed consideration of this special question in this paper. It may, however, be noted that the earliest interpretation, as we find it set down in the contemporary maps, did not name the newly found region Antilia, did not call it Asia, did not indeed call it a newly found continent, but rather a group of islands. Although we read that Columbus undertook to have his men declare their belief that Cuba was the eastward extension of a continent, his first report mentioned that he had found islands. It was not until more than a quarter of a century had passed that we find the map-makers recording a positive conviction of its Asiatic connection. We may, I think, truthfully assert that the moment search began for a waterway leading from Oceanus Occidentalis to Oceanus Orientalis—search following closely upon the failure of the earliest discoverers and explorers to recognize that the real conditions they had found did not tally with descriptions of the far east Asiatic coasts with which they were more or less familiar—the moment this search began, there came to be a quite generally accepted belief that a hitherto unknown continent or region had been found. If then it was a new region of the world, it was quite natural that questions should arise as to its significance for the peoples of the Old World. What could be its real character? What possibilities had

it to offer? The search for the solution of these and of similar queries, as always in like circumstances, ever inspired further discovery and further exploration. Early contemporary convictions respecting the geography of the newly found regions did not long remain settled convictions, and the story is best told by the contemporary maps.

In his *Esprit des lois*, Montesquieu observes that: "In a free nation it is very often a matter of indifference whether individuals reason right or reason wrong; it is enough that they reason, for from that springs liberty." May I not borrow here his thought to emphasize my own point, that, for the progress of geographical knowledge, it was enough that the New World inspired to ever-increasing exploring effort, whether the interpretation as set down in the maps was right or wrong? True it was that new discovery led to new interpretation, and the real geographical facts were continually tempering and influencing these interpretations.

That the earliest discoveries and explorations of the Spaniards, broadly speaking, were largely confined to the border regions of the Gulf of Mexico, was quite geographically logical. Without pausing here to cite the written records in explanation of this fact, we can say that the ocean line of approach from the Old World, the prevailing climatic conditions so like those in the home-land, the discovery of that wealth which so strongly appealed to them, were factors which affected their choice of zone for their exploring activities. The actual geographical conditions to the northward strongly influenced them in their choice of the South, as the map records seem to tell us, and it was but a passing interest in the far North that led the Portuguese into that region—perhaps I may say, a misinterpretation of the geography of the region.

As the search for a waterway through which one might pass onward to the islands and mainland of Asia seemed to be so largely a controlling interest of the early explorers, it is interesting to note here that the early map-makers made record of the possibility of finding such a waterway. With but two or three unimportant exceptions, for the first thirty years and more after the first landfall of Columbus the map records give us that waterway, sometimes a wide stretch of water, but narrowing down in Maiollo's map of 1527 to a "streito dubioso." Subsequently the north continental area, that is, North America, is connected with the south continental area, that is, South America, the northern continent for quite 100 years, and in some of the best of the maps, being frequently laid down as an extension of Asia, an idea which seemed to gain momentum after the reports of Magellan's

voyage, or after the first reports of the Cortes discoveries reached the Old World. If a search for a strait leading out from the Gulf of Mexico into *Mer del Sur* is practically set at rest by the Magellan voyage and discovery, if a further search to southward of the Gulf no longer seriously attracts explorers, with some the region to northward begins to claim interest, an interest only to be satisfied, if then, by finding the Arctic route from the Atlantic to the Pacific.

M. CH. DE LA RONCIÈRE souligne l'importance de la communication du Dr Stevenson qui s'appuie sur ses grands ouvrages consacrés aux portulans et aux globes. Il montre avec sa conférence comment on peut suivre l'histoire de la découverte du monde.

M. DEHÉRAIN désire appuyer par un exemple la théorie développée par le Dr Stevenson de l'utilité des idées imaginaires pour les découvertes géographiques. Au milieu du XVII[e] siècle les Hollandais inventèrent qu'il existait dans l'Atlantique austral une deuxième île Sainte Hélène. Les gouverneurs du Cap de Bonne Espérance organisèrent des expéditions pour la découvrir. Cette théorie erronée eut pour conséquence une exploration détaillée de l'Atlantique austral entre 1660 et 1680.

MR H. YULE OLDHAM, in thanking Dr Stevenson for his remarkable exhibit of slides, pointed out that the portrait shown as of Columbus was the Lorenzo Lotto Florentine portrait of Vespucci. He suggested, as among several reasons for believing that Prince Henry in his expeditions went far beyond the coast of West Africa, the fact that at an early date he secured Bulls granting rights of possession of lands found "even to the Indies," as well as his anxiety, instanced in the case of Cadamosto, to secure Venetians to help him, because the Venetians knew more than others about spices, and because he was convinced that spices were to be found in the lands which he sought.

DR STEVENSON, with reference to the portrait by Lorenzo Lotto, said that, though it might not be a portrait of Columbus, it was certainly not that of Vespucci. In any case it was not now in Florence but in America. The India sought by Prince Henry the Navigator was probably not the India of the Far East, but the India of Africa, *i.e.* Abyssinia.

THE TRADE RELATIONS OF EGYPT IN THE MIDDLE AGES

HUSSEIN KAMIL SELIM

See *Annexes to the Report of the Egyptian Delegates to the Geographical Congress, Cambridge*, 1928, No. 6.

The rôle which Egypt has played, and must continue to play, in the field of world trade cannot be fully understood unless the significance of the country's position be thoroughly grasped. Egypt stands pre-eminently as a link between two widely differentiated regions of the world—the tropical and monsoon lands of the South and East on the

one hand, and on the other the temperate lands swept by the variables to the North and North-west. The varied products of these two vast regions call naturally for exchange. Hence the peculiarly stable rôle that Egypt has played in world trade—that of the highway and the middle region. It does not, however, stand alone in this, since it is merely part of the Middle East, which is itself a vast transition zone and highway between East and West. Egypt has felt the shock of its upheavals, spiritual or secular, and has reacted, often inversely, to the conditions of prosperity, or otherwise, that have obtained in the region as a whole or in part. Hence the prosperity of the trade-route through Egypt—as it is hoped to demonstrate—has depended largely on that of its rival routes passing through the Middle East.

In early times, before man's acquaintance with the sea, all relations between East and West were by land. The sea had then all the terrors of the unknown, and was a great barrier rather than a highway between nations. Sesostris I (1980–1935 B.C.) of the XIIth Dynasty seems to have been the first to utilize the Red Sea highway to the land of Punt and farther east. He even attempted to build a canal to join the Nile to the Red Sea. One must take, however, with great reserve the account given by Diodorus Siculus of the great armaments which Sesostris amassed in the Red Sea, presumably for an expedition to India, since the region was, as it is at present, wholly destitute of the materials necessary for shipbuilding. The impulse given by Sesostris to the trade of his country died with its author, to be revived again, after the lapse of 1500 years under the XXVIth Dynasty of Psammetichus and Necho.

It was not, however, till the age of the Ptolemies that Egypt replaced Tyre as the link between Europe and the Indies. Commerce was greatly stimulated by the changed conditions in Europe, where many nations had begun to emerge from barbarism, with many new needs as well as with the means to pay for their satisfaction. Ptolemy II (Philadelphus) is credited by many classical writers, notably by Diodorus and Strabo, with having successfully constructed a canal to join the Nile to the Red Sea. This appears to have been derived from the old Pelusiac branch of the river near Bubaste (Bilbeis). It had an easterly direction to the Bitter Lakes, passing through the arid Wadi Tumelat, and then turned southward to Arsinoe at the head of the Gulf of Suez. It was certainly the topography of the country which in the first instance suggested the construction and direction of the canal, since the Nile water during flood-time used to find its way to the Bitter Lakes, and these lakes themselves were joined

intermittently to the Red Sea by a kind of distributary across the low-lying country between them and that sea. It seems certain, however, that the canal was only navigable under the early Ptolemies, and the difficulties of its navigation led to its final abandonment. Chief among those difficulties were the facts that it was only in any case navigable during flood-time, that the loss of water by evaporation and infiltration was enormous, that its very slight slope—about 3 or 4 ft. in a distance of 99 miles—necessitated annual and costly dredging operations, and that finally the Bedouins of the region, having lost their monopoly of transport and trade, as well as the age-long benefits they had derived from hiring their camels and raising taxes on caravans, constantly thwarted any attempts to keep the canal in good condition. It is not surprising therefore to find Ptolemy II seeking another outlet for trade between the Nile and the Red Sea. He engineered a highway, amply supplied with wells and rest-houses, across the desert between Coptos and Berenice. This new route, which required at least twelve days to traverse, had the advantage of shortening the navigation of the Red Sea, which was dangerous, and also of tapping the rich mineral resources of the eastern desert, especially that of emeralds and other precious stones. As a result of these efforts, Egypt was, during the reign of the Ptolemies, undoubtedly the principal highway between India and Europe. Alexandria, their capital, was the centre of great learning and prosperity, and its Pharos gave a type to all the lighthouses of the world. After the Roman conquest trade continued to flourish in Egypt. Alexandria, more submissive than Palmyra, had a much happier fate than its rival, and continued to have a unique position in the world of trade down to the time of Justinian (A.D. 527–564).

After the partition of the Roman Empire, however, Constantinople became the centre of gravity of the world. Its nearness to the continent of Asia, therefore, resulted in a rise in the importance of the land-routes passing through northern Iran and Mesopotamia to Asia Minor, and a fall in the importance of the Red Sea route. Since the continental routes were mainly controlled by the Persians, who were the inveterate enemies of the Roman Empire, repeated efforts were made by Roman emperors, especially by Justinian, to revive the trade of Egypt, but with little success. Thus the advent of the Arabs (A.D. 640) found the trade of the country under an eclipse. The navigation of the Red Sea and of the Indian Ocean was evidently attended by too many dangers to be able to compete with the safer land-routes across Persia, and the incorporation of Egypt within the

Moslem Empire resulted in a great fall in the country's foreign trade owing to the religious wars of the period. However, its trade relations with other provinces of that great Moslem fraternity, especially Arabia and Syria, were greatly stimulated. We are told by Al Kindi of the re-opening in 643 of the Nile-Red Sea canal in order to facilitate the sending of corn to Medina. This left the Nile at Fostat and not at Bilbeis as formerly, and thus the difficulty of its former insufficient gradient was lessened. The canal was, however, filled up in 761 by the orders of the Caliph Abu Ga'afar el Mansur, in order to isolate his rival in Medina, Muhammad Ibn 'Abdullah. Alexandria, on the other hand, was joined by the canal Shabur to the Rosetta branch of the Nile at Fuwa, and was thus put into direct water communication not only with Fostat, but also with Kolzum, the predecessor of Suez. Damietta, moreover, was then of far greater importance than at present, principally because of its greater accessibility, due not only to the relative smallness of the vessels of those days, but also to the unsilted character of the Nile mouth at that period. Its trade prosperity, however, was based less on traffic in Eastern products than in native goods, such as sugar-cane, flax, papyrus, etc., to which it had greater ease of access than had Alexandria.

With the development of the taste for luxuries, thanks to Persian and Syrian influences, Arab industry during the Abbasid period received its first impulse and rose to tremendous heights. Under the Fatimid Caliphs, who were fond of display beyond the dreams of even oriental potentates, Egypt was not backward in the arts of adornment. Cairo and Alexandria were noted for their silk and linen fabrics, Bahnasa for its white woollen cloth, magnificent tents and carpets; Dabik, near Damietta, was the centre of the manufacture of robes embroidered with gold, of linen turbans of various colours and of the "Dabiki" cloth adorned with flowers of gold. Asyut made woollen fabrics for turbans, which, according to Nasr-i-Khusrau, were unequalled in the whole world. Tinnis was renowned throughout the East for its fine cambric (qasab) used for turbans, and was the seat of the royal factory (Dar el Tiraz), the products of which were reserved exclusively for the sovereigns of Egypt.

As regards the trade relations with Europe during this period preceding the Crusades, it must be noted that before the Abbasids such trade was very slight, owing to the religious fanaticism of the time, to the Arab naval supremacy in the Mediterranean, usually termed "piracy" by European chroniclers, and to the feudal system in Europe, with its attendant wars and hindrances to commerce and travel. The

diplomatic missions sent by the Frankish emperors, notably Charlemagne, to the Caliphs of Baghdad, between 797 and 825, on behalf of the Christians and pilgrims of Palestine, were almost the only evidence of travel from western Europe to western Asia. The dawn of active trade indeed only came with the emancipation in the ninth century of the Communes, especially Venice and Amalfi, who virtually monopolized the trade of the Levant before the Crusades, and supplied Rome with numerous oriental products which were essential for the religious capital of Europe. The need which these two republics felt, however, for preserving their friendship with Byzantium, which was their nominal suzerain and the greatest Christian power in the East, greatly restrained their trade activities with Egypt. Nevertheless, Amalfi and Venice received many concessions from the Sultans of Egypt, and Venice soon became the principal European market for eastern products, upon which Germany and the northern Italian upland were dependent. The chief articles with which Egypt was supplied by Venice at this period were wood from Dalmatia, iron from the forges of Styria and Carinthia, and slaves from the Caucasian and northern Black Sea regions.

Thus on the eve of the Crusades, the trade of Egypt with Venice, Amalfi and Byzantium was considerable. Moreover, as the Egyptian empire, in the days of Mu‘izz (A.D. 969) included the whole of North Africa, Sicily, Syria and the Hejaz, with its valuable markets of Mecca and Medina, it is safe to assume that trade flowed freely within the different provinces, though we have no data on which to form a judgment. Again, it seems certain that, even at this early period, the Egyptian route to the East had greater attractions for European merchants than had its only serious rival at that time, viz. the Syrian-Mesopotamian route. This was due (1) to its wholly maritime character, which permitted Oriental goods to be offered in Egyptian markets at lower prices than in any other, even in spite of the fact that customs duties were considerably heavier in Egypt than in Syria, (2) to the fact that Egyptian markets were by no means wholly dependent upon Oriental products for their prosperity, but were visited also for native articles, which could be obtained nowhere else with equal ease, (3) the ancient needs of Egypt for wood and iron, of which she is almost wholly destitute, as well as for pitch—in the days of her maritime power—needs which were easily satisfied from southern Europe.

Whatever attractions, however, Egyptian markets may have had for European merchants, were almost nullified by the recrudescence

of fanaticism during the Crusades. Saracen maritime supremacy in the Mediterranean was annihilated, new maritime states were given an opportunity to establish themselves firmly in the world's markets, land routes across Asia were re-opened, and other avenues for trade were either rehabilitated or newly established. With the exception of trade in arms and materials which could be used for shipbuilding, trade with Egypt during the Crusading period was perfectly legal, but it appears that in practice it was generally stopped during the preparation for a new Crusade, with the object no doubt, not merely of depriving the enemy of important articles, so as to cripple his power, but also of ensuring that sufficient transport was available for the conveyance of the Crusaders and their equipment to their destination.

It was not till the time of the attack on and the capture of Constantinople by the "Fourth Crusade" in 1204 that Venice, at last rid of an encumbering alliance, was able to assert her supremacy in the markets of Egypt—a supremacy which had begun to be seriously challenged by Pisa and Genoa.

It would take too long to trace out here in detail the relations between Egypt and the different trading communities of Europe at this period. Suffice it to say that trade was very active between Egypt and Genoa, Marseille, Montpellier, Narbonne and Barcelona. The trade with Narbonne is, however, of special interest, since this port acted as intermediary between England and Egypt, as recorded, for example, by Ibn Said, who mentions that the route passed through Bordeaux—still in English hands—and up the Garonne to Toulouse, whence pack animals conveyed goods to Narbonne. This trade brought tin and copper from Britain to be exchanged with the products of the Levant.

It is of interest to note here the nature of the concessions usually granted by the Egyptian Sultans to the subjects of privileged maritime states. The main concession was generally that of a "fondaco," an Italian word probably derived from the Arabic "fundaq," meaning "caravanserai." At night the "fondachi" were closed from without by a special official, while on Friday they were closed during the Moslem midday prayer, probably to avoid encounters between traders and the mob. The buildings were the property of the Egyptian government, and the expenses of repairs and upkeep were borne by the customs-house department. Each was governed by a resident Consul of the state for the use of whose merchants it had been granted, and he was responsible for order within it. Each had a priest

and a chapel, and each had permission to use its own coinage, weights and measures. The officials were exempt from the poll-tax, even if their stay in Egypt was prolonged for several years. Moreover, by virtue of treaties most foreign merchants had the right of direct appeal to the Sultans, and the consuls were each paid 200 ducats annually by the customs authorities. These concessions furnish ample proof of the importance attached by the Sultans to their relations with western nations.

During the first half of the fourteenth century, the trade of Egypt touched its low-water mark owing to stringent prohibition of trade with it, enforced by the Church after the fall of Acre in 1291. An armed fleet of 35 ships, under the control of the Knights of St John and the Templars, patrolled the Levant to protect the trade of Cyprus and Little Armenia. About the middle of the fourteenth century, this period of great depression came to an end. In 1347 Egypt conquered the kingdom of Little Armenia, and its trading prosperity became transferred to Famagusta. In 1373, however, Cyprus fell into the hands of Genoa, who sought to obtain an exclusive monopoly of its trade by driving away her rivals—to trade herself directly with Beirut and Alexandria. The colonies of the northern Black Sea coasts, though they held out longest, had in turn to succumb to the same fate as had overtaken Little Armenia and Cyprus, losing their eastern trade through the mass conversion of the peoples of Central Asia to Islam, and through the rise in China of the native Ming Dynasty, which was more exclusive than that of Jingiz Khan. Thus the latter half of the fourteenth century and the fifteenth, saw a revival in the trade of Egypt and mark its golden age, at least before the opening of the Suez Canal.

With Asia Minor there were active commercial relations, especially during the latter part of the Crusading era. Behind those relations there was not only a community of religion, but also of political interest, in view of the threatening advance of the Mongols and later of the Osmanli Turks. The trade of Egypt with the lands of the East generally was at this period in a very flourishing condition, owing to the growth of piracy in the Persian Gulf, and to the high prestige of Egypt as the strongest Moslem power, the bulwark of the East against the West. It was, moreover, technically the centre of Islam, since the Caliphs had resided at Cairo after the fall of Baghdad in 1258. The military strength of Egypt secured for it a virtual hegemony over the Red Sea. The Ptolemaic route from Qus to Aidab was still followed, Qus remaining the capital of the province of Upper Egypt.

The importance of Aidab, however, gave place after 1378 to that of Tor on the south-western coast of Sinai. After 1424 Indian vessels and even Chinese Junks deserted Aden for Jidda, which was under Egyptian suzerainty. Henceforth spices arrived regularly at Alexandria in March and September, which accounts for the regular arrival of Venetian ships during those months.

Thus Egypt was, as we have seen, the unrivalled highway between East and West, and all travellers are unanimous in their description of the wealth and prosperity of the country. The repeated disturbances, however, that marked the rule of the Mamluks in Egypt, together with their rapacity and exactions, must have greatly hindered the course of trade. Spices were subjected to repeated taxation on their passage from the Red Sea to the Mediterranean, and at one time Barsbey even attempted to monopolize the lucrative trade in spices, though without success. The country, nevertheless, continued in its commercial prosperity—and reached a very high cultural level—till first the discovery of the Cape route to the Indies brought into the field a most serious rival to its trade, and finally the Turkish conquest of Egypt closed its ports to western traders.

MASTER JOHN DEE: A CAMBRIDGE GEOGRAPHER

E. G. R. TAYLOR

Master John Dee—called Dr Dee by courtesy only—is popularly known as Queen Elizabeth's astrologer. The sensational aspects of his life—for he had a European reputation as an alchemist—have been frequently discussed, but his work as a geographer has been altogether neglected. He played, however, an important part in the English Geographical Renaissance, both theoretical and practical. After a brilliant academic career at St John's College, Dee went to Louvain, as to the "fountain head of learning," where the great cosmographer Gemma Frisius was Professor of Mathematics. From Louvain Dee brought Gemma's improved astronomical instruments, his books, and his globes engraved by Gerhard Mercator, and presented them to Trinity College of which he had been made a foundation Fellow in 1548, when only 21. Returning to Louvain, he cemented his friendship with Mercator—a friendship which lasted through life—and became thoroughly conversant with the cosmographical and cartographical work of the Low Countries. From

Louvain he went to Paris, there to come into close relationship with another mathematician and cosmographer, Orontius Finaeus. Just a little earlier the work of the latter had been severely criticized by the great Portuguese cosmographer Petrus Nonnius for whose work Dee conceived a great admiration. A friendship opened up between the two which led Dee at one time to appoint Nonnius his literary executor.

Fresh from his continental studies and friendships Dee returned to England, and was introduced at the court of King Edward VI in a critical year, 1551. The search for new trades and especially for the way to Cathay had just been mooted, and Dee almost immediately got into touch with Richard Chancellor, the gifted young man who was being specially trained for the office of Pilot Major. Chancellor was a good mathematician and also a good mechanician. He designed improved seaman's instruments, notably a great quadrant, and together with Dee made a series of solar observations preparatory to the voyage. The work of Petrus Nonnius, especially that on the errors of the current navigating charts, the variation of the compass, and the relation of the rhumb line to the Great Circle, as well as the subdivision of an instrumental scale, appears to have been made use of by these collaborators. Chancellor's tragic death in 1556 led to the promotion of Stephen Burrough, a comparatively unlettered man, to the post of Chief Pilot. It was for him, at the request of the Muscovy Company, that Dee invented the Paradoxall Compass—an instrument about which he was very secretive, but which appears to have been designed to give the series of compass directions for approximate Great Circle sailing. At the same time he wrote his *De Nova Ratione Navigationis* in two books (never printed) probably embodying his teaching.

Dee took every opportunity to discuss the results of the Arctic voyages alike with Chancellor, with Stephen Burrough and his brother William, and later with Antony Jenkinson. In the winter of 1562–1563 and again in 1563–1564 he was in Antwerp publishing one of his books and so had the opportunity of making the acquaintance of Ortelius, with whose young English cousin, the diplomatist Daniel Rogers, he was on terms of intimacy. During 1563 Dee travelled over Europe, in the course of which journey he visited Venice, bringing back books and manuscripts, and he may have been the English friend who brought Mercator the MS. copy of the map of the British Isles engraved at Duisburg in 1564.

In 1564 Ortelius published his first world-map, which Dee had the opportunity of buying in the London shop of Ortelius' friend, the

great Antwerp publisher Birckmann. It is worth noting as one of the geographical links between England and the continental geographers that Mercator's son Rumold (Richard Hakluyt's friend) was an assistant in the London branch of Birckmann's business. The Ortelius map of 1564 had a very great influence in England. It was in fact the basis of Humfrey Gilbert's project put forward in 1566 for a search for Cathay by the North-West instead of by the North-East. Gilbert's sketch-map is merely a rough copy of Ortelius' original. Gilbert's arguments were probably in part supplied by Dee who drew up his own "Atlanticall Discourses" at this time. Public interest in the question may be inferred from the current account books of the Plantin Press which show that just at this time a large number of copies of Ortelius' map and of the old-fashioned map of Carl Vopell (which closed the North-West passage) were imported by the London booksellers.

The North-West project however came to nothing, though Dee took care to keep it in men's minds by his references in his famous "Preface to the English Euclid" of 1570—a fine piece of writing that had an enormous influence on his contemporaries. In this preface Dee pointed out that Arithmetic and Geometry were the necessary foundations of all the Arts, and notably of Geodesy or Land Measurement, of Hydrography and of Navigation. It is worth remark that in the following year Dee's ardent disciple Thomas Digges published his late father's *Pantometria* containing the first printed English account of triangulation, and of the theodolite. An example of this latter instrument dated 1574 and made by Humfrey Cole was exhibited to the present Congress at the Science Museum, London.

In 1575 the North-West project was revived and when in the spring of 1576 it became practical politics, Dee was called into consultation by Michael Lok the Muscovy Company's agent and the chief promoter of the voyage, and was also asked by the Company officially to instruct the two leaders Martin Frobisher and Christopher Hall in the mathematical theory of navigation. It was then that Dee, turning over his old notes, evolved quite another scheme for which he sought a patron—finding him in Christopher Hatton. This scheme appears in part to have inspired the famous voyage of Francis Drake[1], of which Hatton was a principal promoter, and involved an approach to the Straits of Anian from the south and a search for the land of Beach or Locach marked on Ortelius' and Mercator's maps as rich

[1] "Master John Dee, Drake and the Straits of Anian," *Mariner's Mirror*, April, 1929.

in gold and silver and lying beyond Java. It was then that Dee planned and began to write his *British Complement of the Perfect Arte of Navigation* embodying all that was most important of his cosmographical and nautical knowledge. The first volume was to serve as a preface, and dealt with the establishment of a Royal Navy in permanent commission which would place England in command of the seas. This volume alone was printed. The second volume, entitled *Queen Elizabeth's Tables Gubernatick*, contained navigation tables including those for the solution of spherical triangles by which relative position on the globe could be determined. The MS. is lost. The third volume was suppressed. The fourth survives in a mutilated MS. under the title *Famous and Rich Discoveries*, with additional chapters on the Septentrionall Islands—Greenland, Iceland and the islands of the pseudo-Zeni map—which Dee claimed to belong to the English crown by right of long-past discovery. It is in this MS., which Purchas unfortunately considered too long to print, that Dee displays his wide reading in cosmography. He corresponded on doubtful points with Mercator and Ortelius and received a visit from the latter at Mortlake in 1577. The main purpose of the volume was to prove the ease of reaching Cathay by North-eastern Asia, since Frobisher's great voyage had revealed the unexpected difficulties of the North-West passage. On the completion of this work Dee spent several days at Windsor conferring with Queen Elizabeth. A week or two later Drake sailed and Dee was able to compliment Hatton on receiving his knighthood.

Sir Humfrey Gilbert's project for colonization had now begun to mature and we find him consulting with John Dee. At a later period Gilbert's fellow venturer Sir George Peckham does the same and sends two of his sea captains to see the great man. Meanwhile however Dee's views on the North-East passage were put to the test by the Pet and Jackman voyage of 1580, and Dee records a visit to Muscovy House to instruct these pilots, while his written instructions were printed by Hakluyt. Unfortunately the map he prepared, showing the rhumb lines truly drawn, has not been preserved. This voyage failing, Dee got into touch with Adrian Gilbert and John Davis as to a renewed venture by the North-West and was named as the chief promoter of the search which became known by John Davis' name. At the same time he extended his aid to Humfrey Gilbert, from whom he had received a concession of part of his discovery, and it was Dee's map prepared in 1582, only recently brought to light[1], which Humfrey

[1] *Geographical Journal*, 72 (1928), pp. 235–7.

Gilbert took with him on the expedition that was to cost him his life.

Unfortunately 1583 saw Dee's association with the fraudulent medium Kelly and his whole energies were turned to crystal-gazing in Bohemia. When he returned to England in 1589 the Armada had been defeated, Walsingham was dead, the way to the Indies lay open, and Cathay was a forgotten issue. John Dee's work for geography and exploration was at an end.

THE ENGLISH CLIMATE IN THE SEVENTEENTH CENTURY

J. N. L. BAKER

Abstract

For a study of the English climate and weather in the seventeenth century and for some years before and after that period a number of important and hitherto neglected sources exist. Foreign visitors to England, among whom were the geographers Ortelius and Cluverius, have left their impressions; Venetian Ambassadors regularly sent home their "Relations"; and English writers in considerable numbers have described the climatic conditions. These accounts do not give minute particulars but they provide a general background against which the more detailed evidence may be placed. The Calendars of State Papers, both Domestic and Venetian, contain a number of particular references to the weather conditions. From these records a reasonably full account of the weather for a number of years can be compiled. More important however are lists of wind directions. The most complete set, covering about ten years in the later part of the century, relate to Deal, but there are other less continuous records for places as far apart as Harwich, Falmouth, and Stockton-on-Tees. The short book by R. Bohun, *A Discourse concerning the origine and properties of Wind* (1671), supplements, in a more general way, these local statistics. Two manuscript journals, covering a total period of about forty-seven years, are preserved in the Bodleian Library. The first and more extensive though less valuable is that of Dr Napier of Great Linford, Buckinghamshire; the second, that of Elias Ashmole, was kept at his house in South Lambeth. Ashmole's diary acts as a useful check on the already known weather record of Towneley, and does not confirm

the large deficiency of rain which those records reveal; other independent evidence supports the belief that the Towneley figures are too low. The Napier diary makes possible a comparison between the weather at the beginning of the century and that at the end, and so far as can be judged from the rather inadequate data there was no material difference. Snowfall appears to have been very much as at present and extensive floods are recorded as isolated and generally exceptional occurrences.

The new evidence available seems to call for a modification, so far as this century is concerned, of the conclusions recently put forward by Dr Brooks, though it may be doubted whether even now sufficient data are available to allow any safe generalization about the climate of England in the seventeenth century.

SECTION F. 19–24 JULY

19 JULY

THE SPELLING AND PRONUNCIATION OF GEOGRAPHICAL PLACE-NAMES FOR BRITISH USE

MAJ.-GEN. LORD EDWARD GLEICHEN, K.C.V.O., C.B., C.M.G., D.S.O.

Other works: *The Permanent Committee on Geographical Names: Geographical Journal*, 1921, LVII, pp. 36–43.

The Decisions of the Permanent Committee on Geographical Names on the Transliteration of Arabic Characters: Geographical Journal, 1920, LVI, pp. 308–13.

THE spelling—not to mention the pronunciation—of foreign place-names has from time immemorial been a stumbling block in the path of English writers. It is astonishing indeed to find in what a variety of ways large numbers of even well-known place-names are spelt; and when we come to the less-known, the chaos is indeed indescribable. For this the English language is largely responsible; for not only does our pronunciation of vowels and diphthongs, as well as of a number of consonants, differ radically from that of most foreign languages—even of those near at hand—but it is wildly inconsistent in itself. Consequently, when our forefathers returned from their travels, they spelt the names of foreign places they had come across according to the good—or, rather, bad—old British way, and were not in the least concerned to find that the foreigners in many cases did not recognize their own towns when named *à l'anglaise*. That was all very well in the old days; but, as means of communication increased, and more and more Englishmen travelled and learnt foreign languages, more and more varieties of spelling were introduced, till at last the confusion, especially on maps and charts, became extremely inconvenient and likely to lead to serious misunderstandings. More especially was this the case in out-of-the-way or newly discovered places, which were often christened with British instead of the true native names. This pestilent habit is even now prevalent in many instances; especially awkward is it where other nationalities, Frenchmen, Germans, and Spaniards, etc. have given their names also to the same localities, thus making confusion worse confounded. [Even in our own country place-names are often very variously spelt; but that is a matter for the Ordnance Survey authorities, and need not be touched on here.]

The first attempt at bringing some sort of order into the matter was made by the Admiralty about 1840, when Captain John Washington, R.N., later Secretary of the Royal Geographical Society, drew up a rough table for the pronunciation and spelling of foreign names. It was recast and published by the R.G.S. in 1885, and consequently became known as the R.G.S. System; but, although sound and practical, the original rules have by no means been universally adopted in Great Britain, and there still flourish on British maps an overwhelming number of place-names which are spelt in a bewildering variety of ways. Some are spelt according to the broadest ideas of British pronunciation; others, with the best intention, are derived by hopelessly false etymology; others again are wrong, obviously from a misunderstanding of the answers of natives, or from a mishearing of the word, or from an inability to convey its proper sound in writing; others again, with every intention of following the R.G.S. System, have gone wildly astray. The question cropped up again during the Great War; for differences in the spelling of numerous names led to many inconveniences and even dangers. Finally in 1919 the Admiralty suggested that the R.G.S. should be invited to form a permanent committee to deal with geographical names, and that all the Government Departments concerned—Adm., W.O., F.O., I.O., C.O., P.O., B.O.T., etc.—should be represented thereon. This was done; and, as all the Departments agreed to accept the spellings to be laid down by the *Permanent Committee on Geographical Names for British Official Use*, it was hoped that these spellings would be widely circulated and be eventually adopted by the Press, by cartographers and writers, and in fact by the public generally. It may be said here that our hopes have been largely realized, and that by slow degrees the spelling of place-names has been improved and is becoming standardized; but a very great deal yet remains to be done.

The first task of the P.C.G.N. was to overhaul the R.G.S. System of 1885 and to lay down an up-to-date, expanded, and accurate system to take its place, giving definite rules for spelling and drawing up a standard alphabet into which to transliterate all foreign sounds. Naturally we accepted, with certain "conventional" exceptions, the native spelling of place-names in countries using the Latin alphabet, and employed our standard alphabet only for transliterating other alphabets—Cyrillic, Greek, Arabic, etc.—or the unwritten names of African, Oceanic, etc. natives. It was shown exactly how each letter, diphthong, etc. of this new standard alphabet, constructed broadly on the basis of using vowels as in Italian and consonants as in English,

should be pronounced, by means of examples of English words introducing the sounds. This System, based on the old and christened the "R.G.S. II System," had to be drawn up with the greatest care; for it was to be the basis of all our future work. Actually it took over a year to draw up; for no sooner had a broad rule, carefully phrased, been formulated than numbers of exceptions or variations in pronunciation appeared as if by magic, all clamouring for settlement. What English word-examples, for instance, could be given as containing an *exact* rendering of the long and short Italian *a*, *i*, or *o*? What sound should the letter *j* represent? How were we to deal with the "neutral" or "indeterminate vowel"? How should the "liquid" sound of certain consonants be rendered in print? And so on, and so on. And with it all we had to restrict ourselves to the ordinary alphabet with no diacritical marks (or barely any); for if we introduced these, they would be very difficult to insert or read on crowded maps, most printers would not have the requisite type, and few people would understand them. One item which delayed us for long was the question whether the letter *q* should find a place or not in the R.G.S. II System; and to arrive at a decision we had first to lay down a scheme for Arabic transliteration, which involved an investigation of the various systems in use and a lengthy cross-examination of experts. What were we to do with a language, extending from Morocco to the Malay States, in which many of the letters and words are pronounced quite differently in different parts of the world? We have to derive what consolation we can from the confession of one of our greatest Arabic scholars, who admits that he has been trying for 28 years to evolve a satisfactory system of transliteration and has not yet succeeded in doing so.

In pursuing our investigation, however, we soon became convinced that a large majority of foreign names, especially European names in the Latin alphabet—with which, it must be remembered, we had bound ourselves not to interfere—would present considerable difficulties to the ordinary Briton as regards pronunciation. Who, for instance, would expect that the Polish name of Lodz (properly Łódź) should be pronounced more or less as Wudsh? Or Qena locally as Enna? Or the familiar Piraeus and Euboea in their Greek forms as Pire-éfs and Évvia respectively? And the *č* and *ć*, the *ą* and *ão*, and suchlike called for urgent explanation. It was therefore determined to draw up pronunciation-tables of the alphabets of a large number of foreign languages, with explanations of their diacritical marks and other oddities. The Secretary to the Committee, Mr J. H. Reynolds,

set to work with a will and, with the help of the author of the present paper and of one or two natives of each country concerned, compiled a book of *Alphabets of Foreign Languages Transcribed into English according to the R.G.S. II System* [*R.G.S. Technical Series*, No. 2]. These comprise not only every European language of any importance, including such near-by tongues as Gaelic, Irish, Welsh, Breton and Icelandic, but also several extra-European, such as Armenian, Hebrew, Amharic, and the varied languages written in Arabic—Turki, Persian, Malay, etc.

The work of the P.C.G.N. has been going on for the last nine years, and about twenty-five lists of place-names have been published, each containing from 200 to 500 words; they deal with regions all over the world and are either general lists applying to continents or detailed lists applying to particular countries. It is not easy to realize, without personal experience, what a number of authorities, human, documentary, cartographical, and otherwise, have to be consulted in order to decide definitely on the proper spelling of each place-name. And even then certain countries such as Norway, Romania, Russia, and Sweden, revise their orthography, and the spelling of names is liable to be altered. The capital of Romania, for instance, used to be officially spelt in six different ways; let us hope it is now permanently settled as *Bucureşti*. Even France has recently altered the spelling of two of her place-names, viz. Cette and Alais to Sète and Alès. Turkey is on the point of adopting a new Latin alphabet to replace the old Arabic characters; when it comes into official use, we shall no doubt be confronted with some novel spellings of Turkish place-names.

Japanese official maps and other publications in Latin characters for many years used the so-called *Hepburn* system of romanization; but the maps issued lately by the Land Survey Department show unfamiliar spellings according to a new system called the *Nippon Romazikwai*, which writes Huzi for Fuji, Tusima for Tsushima, etc.

In Abyssinia where writing is at a discount, and in certain other countries where the native spells the place-name *comme bon lui semble*, how are you to obtain the correct spelling? And in Arabic, where the short vowels are seldom written and certain consonants are pronounced in five or six different ways, how can you arrive at the proper pronunciation and transliteration unless you have been at the place or met someone who has? Even then you cannot be certain.

As regards place-names in our colonies, before publication we always send out a list of such names through the Colonial Office to the Governor of the Colony to be revised by him and by any local

authorities he may consult; we thus hope to be certain of getting the correct pronunciation. With names in the United States and Canada we do not have to trouble; for Geographic Boards dealing with them exist already in both those countries, and we accept their decisions, though not the U.S.G.B.'s spellings of foreign names where they differ from ours. A New Zealand Honorary Geographic Board was provisionally constituted in 1924 and adopted the R.G.S. II System. For India we accept the names as laid down by the Survey, which follows the *Imperial Gazetteer*; and for China we have agreed to take the names as spelt in the *List of Post Offices* published by the Directorate General of Posts, though not in the case of non-Chinese names (Mongol, Tibetan, Turki, etc.). The *List's* system of romanization may be unscholarly and inconsistent; but we have, when deciding on the spelling of a place-name, not only to consider its accuracy according to local pronunciation, etc., but also to make certain that a letter addressed to the place will get there; and these conditions do not always quite coincide. In doubtful cases therefore we incline to the practical side. Lists of names in a foreign country are always submitted to a competent native, who kindly makes the necessary corrections in spelling and pronunciation. We have also to thank several European Governments for financial assistance in publishing the lists.

Many of our difficulties arise from the redistribution of the Map of Central Europe after the War. Many German names have been replaced by Polish (Bromberg by Bydgoszcz), Italian (Bozen by Bolzano), Czech (Brünn by Brno), or Yugoslav (Laibach by Ljubljana); Hungarian by Slovak (Ungvár by Užhorod), Romanian (Nagyszeben by Sibiu), or Yugoslav (Szabadka by Subotica); Italian by Yugoslav (Ragusa by Dubrovnik); Russian by Polish, Lithuanian, Latvian, or Estonian, and so on; and some towns have been entirely rechristened (as Oslo, Leningrad, Peiping), although the countries have not changed hands. It is therefore fairly obvious that our task has been no light one in this respect, and even requires occasional overhauling in order to bring it up to date.

As mentioned above, our standardized spelling is slowly making headway; but out of the millions of place-names in existence we have of course, up till now, only been able to deal with a few thousands; and many names still appear in the Press wrongly and even ludicrously spelt. We have done good work in correcting names in the *Encyclopaedia Britannica* (*Three New Supplementary Volumes* 1926) and in the *Authors' and Printers' Dictionary* (Sixth Edition, 1928) and other

publications; but a serious obstacle is encountered in the fact that many Pressmen—as is only natural—when they come across an unfamiliar name which is not in our lists, look out the spelling in one of the big Gazetteers or Indexes, some of which, compiled many years ago, naturally teem with inaccuracies. One of our leading map-publishers is in entire agreement with the decisions of the P.C.G.N., and hopes to bring out a revised Index in accordance with them; but there are of course many thousand names in it which we have not yet been able to tackle, and in any case a fresh compilation is a serious matter and will take a considerable time.

All that I have said above refers of course only to the spelling of foreign place-names for the use of those speaking the English language. The United States have already laid down the official spelling of names in their own country; and that we adopt without question. But their Geographic Board has now been considering our system in detail with regard to the spelling of names outside the United States, and, I am happy to say, has adopted most of it, the chief exception being that they prefer *zh* to *j* for the *zh* sound in Russian and Bulgarian. (We adopted *j* chiefly because it had been in use by the War Office for many years and also to come into line with the French usage.) The French Geographical Society in 1886 laid down a system for spelling foreign names, thoroughly sound, as far as we can judge, from their point of view; but the pity is that it has not been widely adopted. As far as I know, no other country has definitely moved in this direction, though the question has been envisaged in several countries which are overhauling their spelling of place-names.

It is of course quite impossible to have an international system, however desirable this may seem; for there are so many sounds that are written quite differently according to the language. To take only one out of innumerable instances, the sound written in English as *sh* is in German *sch*, in French *ch*, in Spanish *x*, in Italian *sc*, in Serbo-Croatian and Czech *š*, in Romanian *ş*, in Polish *sz*, in Magyar *s*, and so on. There was indeed a suggestion put forward by the International Hydrographic Bureau a year or two ago that seas, bays, capes, and islands, especially those in out-of-the-way places, should be given definite names to be adopted on the charts of all countries; but no sooner was the question investigated than it was found to be quite hopeless, and the matter was dropped. Until the millennium arrives, when it may be expected that the whole world will speak one and the same language, it is not likely to be resuscitated.

Meanwhile the P.C.G.N. is plodding along dependent (since the

cessation of the Treasury grant in 1922) on voluntary subscriptions from various bodies and individuals, to whom our best thanks are due. Our lists of place-names are very gradually being circulated throughout the English-speaking world; in course of time it may be expected that order will be evolved from chaos, and that every Briton will not only spell foreign place-names according to one standardized system, but also give them, as far as possible, their correct pronunciation. Finally, I cannot close this paper without reference to the excellent work of the Secretary, Mr J. H. Reynolds, to whose care and perseverance we are deeply indebted for the success that has so far attended our scheme.

MR S. W. BOGGS stated that the United States Geographic Board, created by executive order in 1890, necessarily devoted its energies chiefly to fixing the names and the spelling of geographical names in the United States and its possessions. There had been occasion, however, to render decisions concerning many hundreds of place-names foreign to the United States. The difficulties encountered led to the appointment of a committee on the spelling of foreign names, of which the speaker had been made chairman. This committee had now nearly completed a report which embodied a set of rules and standard practice for spelling foreign geographical names. They began by utilizing the very excellent work of the P.C.G.N. The rules and general transliteration table differed only in a few minor particulars from the R.G.S. II System. They intended to revise their earlier decisions to accord with the new rules; and they provided, for the guidance of Government departments and establishments, that in the absence of a specific decision by the United States Geographic Board the decision of the P.C.G.N. should be followed; lacking that, the postal guide of the country concerned, if such a guide were available in roman character; and, if there were no national postal guide, the International Postal Guide (*Dictionnaire des Bureaux de Poste, publié par le Bureau International de l'Union Postale Universelle*) should be followed if applicable. In only one minor particular was the committee undecided in the formulation of their rules; and it was his hope that before leaving London he would be able, with the assistance of Mr Reynolds, to obtain the data necessary to enable the committee to dispose of the remaining question of principle. The programme which they were following would bring into substantial agreement the spelling of foreign geographical names in the English-speaking countries.

MR J. H. REYNOLDS wished to stress the point that in preparing the lists of place-names the P.C.G.N. took the utmost care to obtain the opinions of the best authorities available. As an instance of that he could mention that a List of Names in Poland now in preparation had received a very thorough revision at the hands of the President of that Section, Prof. Romer.

THE BASINS OF THE CONGO AND KASAI

T. ALEXANDER BARNS

Other works: *The Wonderland of the Eastern Congo*, London, 1922, 288 pp.
An African Eldorado: The Belgian Congo, London, 1926, 230 pp.
Angolan Sketches, London, 1928, 206 pp.
The Mokoto Lakes, Western Rift Valley: Geographical Journal, 1922, LIX, pp. 356–63.
A Trans-African Expedition: Journal of the African Society, 1925, XXIV, pp. 272–86.
In Portuguese West Africa: Geographical Journal, 1928, LXXII, pp. 18–27.

Abstract

Since Stanley, Lovett Cameron, von Wissmann, and others first explored the vast area of the Congo Basin and the neighbouring country of Angola, great interest has always been attached to these remarkable regions. The Congo Basin can be described in all truth as the Live Heart of Africa and, like a great hot-house or breeding-ground of human, animal, and plant life, it holds questions of vast import for the future.

For many years past the author has had the privilege of carrying out scientific exploration work in all parts of this Congo country, especially in its eastern areas along the equatorial snow-crowned Ruwenzori Mountains and the imposing range of active volcanoes known as the Mfumbiro or Virunga Mountains. The latter have become famous as the habitat of the long-haired Beringe's gorilla; and both regions are unique as regards their semi-alpine flora and fauna at the 12–13,000 ft. levels. On the western slopes of these great ranges are also to be found some of the most interesting native communities that remain in Africa to-day, such as the Wambutti and Watwa pygmies and the Nilotic Watusi—in fact, from the human aspect this region may be described as "the Cradle of the Bantu," and it is the only region that now remains in the Congo Basin that has not yet been reached by the progressive industrialization of the country set afoot by the Belgians.

With regard to Angola, which occupies a considerable portion of the Kasai Basin, its central plateau area is, in many respects, one of the most remarkable water-partings in Africa. It has a mean elevation of about 5000 ft. This great tableland acts like an immense sponge or reservoir, storing up vast quantities of water during the rainy season and giving them out during the dry, giving rise to a group of splendid rivers which lie within the drainage area of the Atlantic, the Congo, the Zambezi and the inland basins of Lake Ngami, Chobi, and the

Etosha Pan. These rivers flow to all points of the compass, first finding an even course through highland forests and open plains and then tumbling over the far-flung ramparts of the plateau in a series of cataracts and waterfalls, finding their way into the sea by devious courses, some to the Atlantic by way of the Congo, others to the Indian Ocean down the great waterway of the Zambezi.

Having a unique set of lantern slides, the author used these to emphasize his descriptions of the flora and fauna of these countries and, at the same time, he touched on the industries where these are of outstanding importance.

REGIONAL PLANNING IN ENGLAND AND WALES

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Other works: *British Conurbations in* 1921: *Sociological Review*, April, 1922, pp. 91–9.

New Plans for Industrial Development: Geographical Journal, 1924, LXIII, pp. 440–2. [*Review of Doncaster and Deeside Regional Planning Schemes.*]

Leeds and Bradford Region Joint Town-Planning Committee: ibid. 1927, LXX, pp. 169–70. [*Review of Report.*]

In this country the Industrial Revolution of the eighteenth and nineteenth centuries gave us an unprecedentedly rapid increase and redistribution of our population during the last hundred years. Since 1821 the population has multiplied threefold. Moreover, the whole of this increase has been concentrated into the towns, and there has been a general decline in our rural population. The nineteenth century was also, in economic, social, and political thought, largely dominated by the policy of *laisser faire*, and during its early decades there was no adequate system of Local Government in or for the growing towns of the industrial regions. Hence the spread and growth of our towns was almost uncontrolled. There was no systematic planning; in the heyday of our railway system even our main roads were neglected, and such control as was exercised in the latter part of the last century was almost limited to the enforcement of the minimum standards of sanitation laid down by the Public Health Acts. Before the end of the nineteenth century this haphazard expansion of our towns had given us the vast industrial slums of which so many hard things have justifiably been said, and the still vaster respectable, sanitary, and dismal working-class quarters of our larger industrial cities. And public opinion was being awakened to an interest in problems of town-planning.

Pioneer efforts, as is usual in England, were voluntary. But my subject is not Town-Planning as such, and I need only note that the material achievements of the Town-Planning Movement itself date back no further than the first decade of the twentieth century with the foundation of Letchworth Garden City and the Hampstead Garden Suburb. The latter, which celebrated its "coming-of-age" last month (June, 1928) has been the forerunner of a large number of suburbs now in existence or building. During the first ten years or so of the Town-Planning Movement efforts were almost wholly limited to towns, new and old. And in so far as its advocates thought of rural areas at all, they seem to have regarded them primarily as places wherein towns or suburbs might be planted.

But a few years' experience, marked by the coming of the motor-car and its accompanying rediscovery of our countryside, has compelled a general recognition of the fact that the proper unit-area for the planning of the better human occupation of our country is not the town but a much wider "region." And the Town-Planning Act of 1919 permitted the establishment of Joint Town-Planning Committees[1] representing and appointed by groups of Local Government Authorities for the purpose of co-ordinating town-planning schemes or even of extending or preparing such schemes. The formation of these Committees has been aided and encouraged by the Ministry of Health. We may note some important features arising from their composition before indicating their work.

First: the establishment of such a Joint Committee is permissive and not obligatory for the Local Authorities concerned. Hence it has been possible for local jealousies and particularisms to limit their areas and powers; but also they have had many advantages of voluntary co-operation with non-official bodies.

Second: the "Regional" Committee is usually an advisory body only[2]; for the majority of Local Authorities are unwilling to surrender executive powers to it. This limitation has incidentally favoured the presence of unofficial co-opted members on these Committees and given them a freer hand than they might have had otherwise. And since it means that they must convince the Local Authorities of the soundness of their plans, it tends to ensure fuller discussion.

Third: the "regions" for which Joint Town-Planning Committees are set up are more or less chance groupings of contiguous Local

[1] Within towns of more than 20,000 inhabitants the preparation of a town-plan is obligatory. Co-operation with neighbouring authorities is optional.

[2] Eight of them have executive powers. See Appendix A.

Government Areas. They are rarely natural units, though they have in many cases a real geographical unity. Two of the latest "regions," Oxfordshire and Leicestershire, each cover an administrative county with its associated boroughs; but the great majority consist essentially of an urban area—a town or group of towns—with its suburban districts.

The first Joint Planning Committee to be established was that for the Doncaster "region," 31 May 1920. The second, eight months later, was that for the Manchester "region" which was formed by no less than 96 Local Authorities. The total number established to the present is 58, of which 54 are in England and 4 in Wales[1]. In Scotland there is 1 in existence and there are 3 in process of formation. The total area of the "regions" covered by these 58 Committees is a little more than one-quarter of that of the country; but the population included is more than three-quarters of the total. This proportion emphasizes the fact that the movement has hitherto been mainly urban—a fact which would be still more marked if we omitted the four "regions" constituted this year (1928) which are largely rural. "Regional" planning as it is to-day is an out-growth and extension of "Town-Planning." It is rarely "regional" in the geographer's sense of that term. Of the 58 "Regional" Committees established, 16 have published Reports[2], most of which are regarded as preliminary; and 2 have also published Final Reports and plans, the execution of which is left to the Local Authorities concerned. Hence it is clear that the work is still in a very early stage.

Some few points in the grouping of particular "regions" may be noted here. On the north-east coast there are five such regions, where a geographer would have recognized only two, or at most three. They are (*a*) North Tyne and South Tyne, (*b*) North Tees and South Tees and the Hartlepools. The first two pairs are in each case so obviously one region that some explanation of the separation is urgently needed. The rivers Tyne and Tees are county boundaries of very long standing (> 1000 years); and the County of Durham between them has insisted on refusing to combine with its neighbours even for this purpose, although many voluntary associations in North-east England ignore these boundaries. And in fact these Committees have found it necessary to co-ordinate their schemes to a large extent. In contrast to this prominence of county boundaries in the north-east (and elsewhere) there are several joint planning "regions" which overlap such boundaries; *e.g.* the Manchester and Midland (Birmingham) "regions"

[1] For names and statistics of these see Appendix A.
[2] For list of these see Appendix B.

each extend into three counties, while the Deeside "region" is partly in England and partly in Wales.

There are at least two distinct aims, expressed or implied, underlying plans which have been prepared so far. One of these is expressed in the report of the first "Regional" Planning Committee, which says[1]: "It is no longer, one hopes, possible for a single city of the numbers and density of Leeds or Sheffield to come into existence; and one contemplates with only less horror a town, equal in population, but with its people spread out at the rate of fifty to the acre." That report was published in 1922, and already settlement in the Doncaster neighbourhood is making for more centralization on the focal town than was anticipated. Hence it seems probable that the second aim which plans for the concentration of much more of the life of the urban "region" on its "capital" and regards outlying areas as "suburbs" is more in harmony with the actual trend of growth.

In most cases the whole of any one distinct industrial district is in the area of one Joint Town-Planning Committee, except on the North-east Coast. But a notable exception is the division of the West Yorkshire conurbation, the "Woollen District." Here there are two such "regions," the Leeds-Bradford and the Huddersfield-Halifax, the second of which is still only "proposed." The grounds of division appear to be (*a*) the Local Authorities of the first "region" were willing to co-operate while the others were not; and (*b*) the Leeds-Bradford "region" with a population of more than 1¼ million people is sufficiently large to provide work for such a Committee, though it is less than half as populous as the Manchester "region[2]." But it is probable that the real reasons for the division of the West Yorkshire conurbation are local rivalries. The division has no geographical nor economic justification; for the whole of this industrial region is essentially one unit area for regional planning.

This Leeds-Bradford "region," whose preliminary maps are to be seen, will serve to illustrate some general features of most of our "regional" planning. The map is a copy of the O.S. 6 in. to 1 mile map, reduced to half that scale and overprinted to illustrate the proposals of the Committee. The boundaries of the "region" are those of the 50 Local Government Areas included. There are 51 Local Government Authorities concerned, including the West Riding County Council; but of these only 43 had combined to form the Joint Com-

[1] *The Doncaster Regional Planning Scheme*, p. 4.

[2] The work of planning the Manchester "Region" has been divided among nine decentralized Joint Town-Planning Committees.

mittee at the date of this Preliminary Report. To the west and south-west the boundary lies on high unoccupied moorlands and is obviously a natural and satisfactory limit. To the east it is so drawn as to include the present urban areas (*i.e.* areas actually, or in process of becoming, urbanized)—a policy which was general in the delimitation of these Joint Town-Planning "regions." But in this case the steady eastward movement of the effective coalfield towards the "buried" coalfield will probably call for an extension of the planning in this direction. The extension will also be required if the project for a Ship Canal to Leeds is realized. To the north the boundary is for the most part drawn along the river Wharfe so as to include the south side of Wharfedale, which is partly occupied by residential suburbs, but to exclude the opposite. The line is hard to justify. A Pennine dale is a very definite geographical unit; and the sunward slope of the valley is rapidly becoming the favoured slope for residence wherever it is sufficiently accessible from the cities. The southern boundary cuts through the industrial region, as we have already noted.

Within the "region" the proposals for "zoning" the land surface for use for various purposes—industrial, residential, agricultural, recreational, and so on—are akin to those made in other regions. It is proposed that heavy industries, which are very prominent here, should have first claim on the low, flat areas in the valley-bottoms which are served by canal, railway, and main road. Special provision is made for certain industries, sometimes called "offensive" industries, such as leather-manufacture, the making of artificial manures, and some other branches of chemical industry, which are also to be kept to the valleys, partly because they share the characteristic transport needs of heavy industries and partly to separate them from residential areas. Lighter and inoffensive industries may spread more widely, especially where they use electric power, as many do now, and so avoid both the work of transporting their fuel and the emission of smoke.

Later developments of regional planning include two which should be mentioned even in so brief a survey as this. As I have said, the movement began in, and with, the towns, where it was, and is, most needed. It was extended beyond single towns when the Joint Town-Planning Committee became possible in 1919. And these committees have now extended the work to some considerable rural areas such as Oxfordshire and part of the Lake District.

In another direction there has arisen a group of vigorous voluntary associations of which a typical member is the Council for the Pre-

servation of Rural England. These associations foster and focus a strong movement for the preservation of the beauties and amenities of the country and they are a real power in the land. This voluntary movement sometimes leads its supporters into extravagant absurdities, of which I take an example from last Sunday's *Observer*[1]: "Nothing short of a deluge or an earthquake can now substantially improve most of the northern industrial towns. Before the Industrial Revolution our towns were all beautiful and the country all undefaced. Ugly architecture had not been invented." But in spite of such absurd extravagances and of the limitations of vested interests in our Local Government Areas, the movement towards the planning out of the whole of our country to make of it a better home for our people is gaining force. Its enemies are on the one side the "philistine" and on the other the unbalanced enthusiast to whom everything old (beyond a certain date) is beautiful and everything modern is ugly. At present the movement is mainly local and voluntary, and it is to be hoped that it will remain so as far as possible; for centralized control and compulsion are inevitably opposed to the perpetuation of the individual and local variety to which so much of the charm of England is due.

APPENDIX A

Joint Town-Planning Committees

No. on map and name of committee	Date of constitution	No. of Local Authorities	Acreage (1921)	Population (1921)	Assessable value (£)
NORTHERN					
1 Doncaster	31. v. 1920	8	108,465	139,938	1,013,354
2 Manchester	14. i. 1921	96	633,361	2,782,394	17,864,263
4 South Tees	22. ii. 1921	7	38,707	210,262	1,145,082
3 Deeside	24. ii. 1921	6	67,558	81,716	491,490
6 South Tyneside	2. iii. 1922	16	99,401	741,728	3,124,671
7 North Tyneside	28. iii. 1922	14	137,237	533,887	3,409,901
8 Rotherham*	16. v. 1922	7	67,856	156,064	824,178
10 Wirral Peninsula ...	8. ix. 1922	8	59,653	315,780	2,096,440
14 Lancaster and Morecambe	23. iv. 1923	5	68,188	77,328	446,230
17 Leeds and Bradford ...	10. vii. 1923	43	249,743	1,266,495	8,302,863
21 North Tees*	6. ii. 1924	3	20,583	75,511	465,806
In 27 Great Crosby and District	23. vi. 1924	4	14,937	64,374	443,467
31 North-east Lancashire ...	20. v. 1925	25	388,518	548,582	2,708,356
37 Preston and District* ...	28. ix. 1926	5	62,273	166,403	935,480
27 South-west Lancashire ...	24. i. 1927	19	187,926	1,249,533	9,674,620
45 Fylde Region	18. iii. 1927	8	113,482	165,115	1,697,325
47 Lake District (south) ...	26. vii. 1927	4	187,283	30,162	235,880
48 Sheffield	5. x. 1927	21	186,072	772,375	3,768,332
Hartlepools	13. iii. 1928	2	22,509	93,302	—

[1] *Observer*, 15 July 1928.

Joint Town-Planning Committees (continued)

No. on map and name of committee	Date of constitution	No. of Local Authorities	Acreage (1921)	Population (1921)	Assessable value (£)
MIDLANDS					
9 Mansfield	18. v. 1922	7	81,172	93,753	414,025
18 Nottingham	22. x. 1923	13	174,375	414,261	2,200,205
20 Midlands...	13. xii. 1923	67	854,640	2,407,487	12,149,041
25 North Staffordshire ...	11. iii. 1924	14	272,396	454,984	2,046,214
26 Chesterfield	9. iv. 1924	8	115,175	186,443	762,231
34 Mid-Cheshire	27. i. 1926	15	381,687	228,925	1,232,432
43 Woodbridge*	11. i. 1927	2	1,554	—	—
51 Leicestershire	29. ii. 1928	17	259,709	196,587	—
SOUTHERN					
5 West Middlesex... ...	12. i. 1922	16	72,208	408,194	2,940,442
11 North-east Surrey ...	16. x. 1922	12	80,889	484,291	3,541,317
12 Thames Valley	17. xi. 1922	12	31,580	266,920	2,206,966
22 South Essex	7. iii. 1923	12	187,227	606,047	3,058,465
16 East Kent	14. v. 1923	17	185,995	298,938	1,699,142
24 Bristol and District ...	31. i. 1924	14	321,525	619,105	3,654,271
28 Worthing and District ...	12. xi. 1924	3	15,156	41,455	283,310
29 North-west Kent ...	20. xi. 1924	15	161,613	322,460	2,303,336
30 South-west Kent ...	10. ii. 1925	10	225,807	157,157	1,262,649
32 Hertfordshire	25. v. 1925	35	404,523	333,195	2,191,624
33 Arundel and District ...	25. ii. 1926	5	96,683	50,307	313,853
In 32 Bushey and Watford* ...	27. v. 1926	2	5,383	—	—
35 Mid-Surrey	10. vi. 1926	6	104,502	87,846	723,581
38 North-east Kent ...	2. vii. 1926	15	211,939	295,715	1,399,749
39 Brighton and District ...	26. vii. 1926	9	33,852	223,608	1,720,020
36 West Surrey	23. ix. 1926	7	149,305	113,408	774,994
40 North-west Surrey ...	14. x. 1926	7	61,145	91,676	713,317
41 North Middlesex ...	16. xi. 1926	16	71,967	809,257	5,817,090
In 32 Mid-Hertfordshire* ...	13. i. 1927	3	15,521	—	—
42 South Buckinghamshire	14. i. 1927	13	214,361	217,352	1,132,880
49 Eastbourne and District	—	4	100,104	93,291	718,893
46 Berkshire...	18. vi. 1927	15	323,773	173,573	1,140,114
44 South-east Sussex ...	27. x. 1927	8	151,616	121,694	980,613
Greater London... ...	2. xi. 1927	126	1,135,000	8,000,000	82,000,000
50 Oxfordshire	—	18	470,762	130,579	644,447
Folkestone and District*	—	3	3,915	46,767	—
52 Basingstoke and District*	—	2	76,956	25,362	—
WALES					
13 East Glamorgan... ...	7. iii. 1923	15	221,034	812,579	3,904,451
15 Mid-Glamorgan... ...	2. v. 1923	7	110,579	113,571	463,397
19 Afan and Neath... ...	29. xi. 1923	4	90,794	118,626	511,851
23 West Glamorgan ...	5. ii. 1924	8	230,190	318,254	1,377,988
58 Joint Committees ...	... Totals	†883	10,420,364	28,834,616	205,000,000

* Joint Committees with executive powers (8).

† About 150 of these are in more than one Committee, especially in the Greater London Region.

The numbers on the map are those employed by the Ministry of Health. The map gives the position at the end of 1928 and includes three additional Regions: (53) North Wales, (54) Mid-Northampton, (55) Cambridgeshire. Regions 11, 29 and 30, also 5 and 12 overlap.

APPENDIX B.

REGIONAL PLANNING: LIST OF PUBLISHED REPORTS (TO JULY 1928).

The Doncaster Regional Planning Scheme. Messrs Hodder and Stoughton, Ltd., Warwick Court, London, E.C. 10*s.* net.

The Deeside Regional Planning Scheme. Messrs Hodder and Stoughton, Ltd. 7*s.* 6*d.* net.

The West Middlesex Joint Town-Planning Committee. Preliminary Report upon the Regional Survey. Mr E. S. W. Hart, Guildhall, Westminster, London, S.W. 1. 5*s.* net. *Final Report and Plans.* 10*s.* 6*d.*

The Thames Valley Joint Town-Planning Committee. Preliminary Report upon the Regional Survey. Mr W. T. Goodale, Council House, Mortlake, Surrey. 3*s.* 6*d.* net. *Final Report and Plans*, 8*s.* 6*d.*

Rotherham Region Report. Mr C. L. des Forges, Town Hall, Rotherham. 7*s.* 6*d.*

East Kent Regional Survey. Mr F. A. Cloke, 51 Strand Street, Sandwich, Kent. 10*s.*

South Tees-side Regional Report. Mr Preston Kitchen, Municipal Buildings, Middlesbrough.

Wirral Joint Town-Planning Committee. Mr E. W. Tame, Town Hall, Birkenhead.

Leeds and Bradford Region. Mr T. Thornton, 11 Park Square, Leeds.

Lancaster and Morecambe Region. Messrs Hodder and Stoughton, Ltd. 10*s.*

Manchester and District Joint Advisory Committee. Report and Plan. Mr P. Heath, Town Hall, Manchester.

West Kent Regions Report covering South-West Kent and North-West Kent Regions. Messrs Vacher & Sons, Ltd., 10 Great Smith Street, Westminster, S.W. 1. 10*s.* 6*d.* or 11*s.* 6*d.* in stiff board; postage extra.

Chesterfield Joint Town-Planning Committee. Messrs Bales and Wilde, Gluman Gate, Chesterfield. 11*s.* post free.

North-East Surrey and West Kent Joint Town-Planning Committee. J. M. Newnham, Esq., LL.D., Town Hall, Croydon. 3*s.*

Hertfordshire Regional Planning Report. Messrs Vacher & Sons, Ltd., 10 Great Smith Street, Westminster, S.W. 1. 7*s.* 6*d.*

Mid-Surrey Joint Town-Planning Committee. Mr Alfred Smith, Town Hall, Reigate. 10*s.* 6*d.*

THE MORPHOLOGY OF MARMARICA AND THE LIBYAN DESERT

DOTT. A. DESIO

Other works: *Appunti geografici e geologici sulla Marmarica Orientale Italiana: Bollettino della Reale Società Geografica Italiana*, Roma, 1927, Ser. VI, Vol. IV, pp. 6–18.

Notizie geologiche e geografiche sull' Oasi di Giarabùb e sul Deserto Libico: Ibid. pp. 115–45, 227–55.

Resultati Scientifici della Missione alla Oasi di Giarabùb (1926–7): Fasc. I. *La Morfologia*: Fasc. II: *La Geologia: Reale Società Geografica Italiana*, Roma, 1928, 163 pp.

Sugli spartiacque della Cirenaica: Bollettino della Reale Società Geografica Italiana, Roma, 1929, Ser. VI, Vol. VI, pp. 19–26.

Abstract

In traversing the large territory extending southwards from the Marmarican coast to the heart of the Libyan desert it is easy to

observe a characteristic morphological progression of zones, that is, a succession of regions with peculiar land-forms but also with perceptibly different climatic régimes and biological surroundings.

The coastal region is characterized by one or more systems of marine terraces ending seawards in cliffs. These systems diminish from West to East, but the change in level is, on the whole, fairly uniform.

We may consider the limit between the first and the second region to be the water-parting, which generally runs a few kilometres from the coast.

The highlands region, slightly tilted southwards, extends flat, bare and uniform for the extent of several hundreds of kilometres and is interrupted southwards by a chain of depressions. It is a calcareous *hammada*, sprinkled with very wide cavities, not very deep, (*balte*), furrowed by several arid wadis, and on the inner side it is successively replaced by *serir*.

The closed-basins region is formed by a chain of very wide depressions whose lowest parts lie below sea-level. In these Siwa, Giarabub (Jaghbub), and Gialo (Jalo) Oases are situated.

Finally the continental sands region (*Grande Erg libico*) is characterized by a succession of long sandhill chains generally directed 10° E. and covering a highland slightly tilted northwards. On the western side the Libyan Erg ends nearly on the line of the Gialo meridian. Under the sands the existence of long wadis, sunk in the rock in places, is hardly visible; they present the same orientation as the sandhill chains.

The continental phase in the above region began during the Upper Miocene in consequence of the raising of the highland of the Great Libyan Erg and of the Marmarica highland; this raising, having been chiefly accentuated at the northern and southern ends, formed a huge valley in the closed-basins region.

Since then two consequent wadi systems began to develop, directed towards common collectors which opened towards the Gulf of Alexandria and the Syrtic Gulf. This erosion cycle evolved regularly, forming the Marmarican wadis and the wadis submerged in the sands of the Great Libyan Erg.

The closed basins correspond to the zones of the confluence of the wadis with the collectors. The progressive aridity of the climate, in consequence of the retreat of the sea, determined the general morphology and a partial transformation which gave rise to the present forms. In this respect the geological conditions of the region also play an important part.

20 July

NOTES ON THE GIARABUB (JAGHBŪB) OASIS FROM THE RESEARCHES OF THE ROYAL ITALIAN GEOGRAPHICAL SOCIETY'S EXPEDITION (1926–7)

DOTT. A. DESIO

Other works: see p. 461.

Abstract

The Giarabub (Jaghbub) Oasis lies 250 km. from the Mediterranean coast, near the first sandhills of the Great Libyan Erg, and it stretches from 29° 40′ 4″ and 29° 50′ N. lat. to 20° 20′ 30″ and 25° E. long. from Greenwich meridian. To the north, the immense Marmarican highland lies uniformly flat and bare; to the south is the Great Libyan Erg with its countless sandhill chains, directed towards S. 10° E. On the eastern and western sides other depressions like those of Giarabub are ranged in a row.

The oasis is contained in a basin of 1000 sq. km.; this basin in some parts descends below sea-level and is bordered all round by rocky declivities of 50–100 m. height. The Giarabub basin, misnamed Wadi Giarabub, is divided into three great intercommunicating basins of irregular form and subdivided into smaller cavities named *hatiyas*.

The *hatiyas* are characterized by a flat bottom and by an alluvial soil, salt, swampy, often covered with halophytic vegetation. Here and there are also some lakes (*bahr*) the largest of which, the Bahr el Harrasha, is 9·4 km. in width. The three basins are separated by little *jebels* or by a series of *qaras*, which often also separate the *hatiyas*.

The Wadi Giarabub is cut in sandy calcareous rocks of the inferior Miocene (Langhiano), which are very rich in fossils and are of an erosive origin, though we can say that tectonic phenomena were not absolutely absent in its first formation. The climate, of desert type, is characterized by sufficiently high temperatures (annual average 23·9°); the prevailing winds are northerly in summer and southerly in winter. Wells are relatively abundant, but they are all, more or less, rich in magnesium and calcium salts. The best spring is the 'Ain Zawiya which gives potable but salt and bitter water.

The oasis is inhabited by about 200 people, Arabs and blacks, all collected in the zawiya enclosure, founded in 1856 by the first Senusso whose ashes are preserved in the Mosque. The local products, except dates, are very slight, cultivation being limited to the little gardens arranged in the palm-grove near the zawiya. The fauna is

relatively scarce. Among the most common and notable animals we may note jackals, antelopes, pyramid-mice, marabout birds, moorhens, lizards, jekoes (jeki), chameleons, serpents, toads, etc. In the salt lakes there are some fish. The flora is sparse to the same extent, and only 63 species are known up till now amongst the indigenous and cultivated plants of the oasis.

L'ORIGINE DES NOMS DE LIEUX AU SPITSBERG

PROF. GEORGES PARMENTIER

[This paper was for the most part a French version of part of an English paper by Gerard de Geer, *The Coal Region of Central Spitzbergen: Ymer*, Stockholm, 1912, XXXII, pp. 345–63.]

PROF. W. WERENSKIOLD explained that the Norwegian domain in the Arctic Ocean includes the islands between lat. 74° and 81° N., all the islands lying in this area together being called Svalbard; Spitsbergen is the chief group.

In 1924 a committee was appointed by the Norwegian Government to propose the place-names for a general map. The work was continued on a broader basis at the office of the Svalbard Expeditions to be completed in the autumn of 1928 and published. A regular chaos of names exists of different periods and origins; and the nomenclature must be brought into order somehow. It is necessary to start with certain principles, modified by judgment. The Norwegian language should be used. The original names should be reinstated—that is, the oldest that can be safely identified—if not altogether obsolete. Sometimes a name has been so securely fixed to the wrong locality that it must be left there. When the names are pure appellatives which have generally been translated on the charts, then they are to be translated into Norwegian too. Instead of *Bay* is used *fjord* or *bukt*; also *Montagne*, *Mount*, *berg*, etc. are replaced by *fjell*. No duplications are allowed; if the same name is found at different places, only the oldest is allowed to remain. In order to prevent further uncertainty and complication, for the future all proposals for place-names will be sent to the office of the Norwegian Svalbard Investigation, where the lists will be gone through and a report sent to the Government for decision.

DR RUDMOSE BROWN approved of the general principles of the Norwegian system of nomenclature for Spitsbergen and expressed his appreciation of the great difficulties that had to be faced in unravelling the complexity of the subject. He regretted, however, that the practice of translation into Norwegian was carried so far as to include appellatives which stood as proper names. Thus for instance the translation of certain Gaelic names on Prince Charles Foreland was undesirable, even if their pronunciation was difficult. The practice of demanding that all new names should be submitted to the Norwegian Government in future was a council of perfection, but it could not be enforced; and there were other than Norwegian maps of Spitsbergen and always would be. The prestige of the British Admiralty Charts could not be forgotten.

AN ATLAS OF ITALIAN LANDSCAPE

PROF. A. R. TONIOLO

See *Saggio di un Atlante del Paesaggio Italiano*, *Essay of an Atlas of Italian Landscape*: G. Bognetti and A. R. Toniolo: *Comitato Geografico Nazionale Italiano*, *Touring Club Italiano*, Milano, 1928, 19 pp., 19 plates; (in Italian and English). [Presented to Congress.]

Abstract

The importance of pictorial illustration for the study of geography has given rise to many proposals to enrich the teaching of the subject with this indispensable aid. The last International Geographical Congress held in Cairo (1925) voted that the International Geographical Union should favour initiatives (as M. Chaix's *Atlas des formes du relief*). In Italian Geographical Congresses, from that of Venice in 1907 to the last at Milan in 1927, we voted that similar initiatives might be realized also for Italy. The great scientific and practical difficulties in the way of such publications have retarded their execution hitherto.

We hope, though, to prepare at last in Italy the organized undertaking of an *Atlas of Italian Geographical Landscape*. The Italian Touring Club has accepted for the present the proposal to compile a topographical record of Italian landscape which must be the basis for the eventual publication of an Atlas. The National Italian Geographical Committee has nominated a Commission for the practical study of the proposal; to this we owe the summary presented to the Congress at Cambridge. Differing from other proposals and International initiatives, the Italian work should be a real Landscape Atlas, not only morphological but also bio- and anthropogeographical and should include the whole of Italy, which from the nature of its situation, soil, surface features, and climate, presents a very great variety of landscapes and geographical forms, perhaps more than any other European region. It is understood of course that purely artistic pictures of scenery and people should be excluded from it and that photographs must be collected, as far as possible, showing the relationships existing among the various facts of distribution. The Italian Touring Club and the Italian Geographical Committee present to the International Geographical Congress at Cambridge a specimen of what the future Italian Geographical Landscape Atlas should be, complete with topographical maps referring to the illustrated areas and with a brief note of explanation.

21 July

THE TENBY COAST: A LOCAL SHORE STUDY

H. C. DARBY

From an engineering viewpoint the study of shore-lines has received a considerable amount of attention in Britain. But still wide differences of opinion exist as to the agents affecting longshore transportation of material, and the question of the vertical movement of sea-level in historical times. One of the elements in the cause of this confusion of thought is that isolated observations have often been made a basis for generalization. It would seem therefore that any ultimate solution of these and kindred problems can be obtained only by numerous detailed examinations of small stretches of shore-lines and by a systematic co-ordination of their results.

The coast of Pembrokeshire, South Wales, constituted a typical "ria" shore-line at the close of the Neolithic submergence. Most of the inlets have disappeared owing to natural causes and human agency. This paper is concerned with the development of a typical inlet, the Ritec valley, near Tenby. Our study resolves itself into three parts:

(1) the presentation of evidence to show that the Ritec valley has been an arm of the sea within historical times;

(2) an account of the local shore processes;

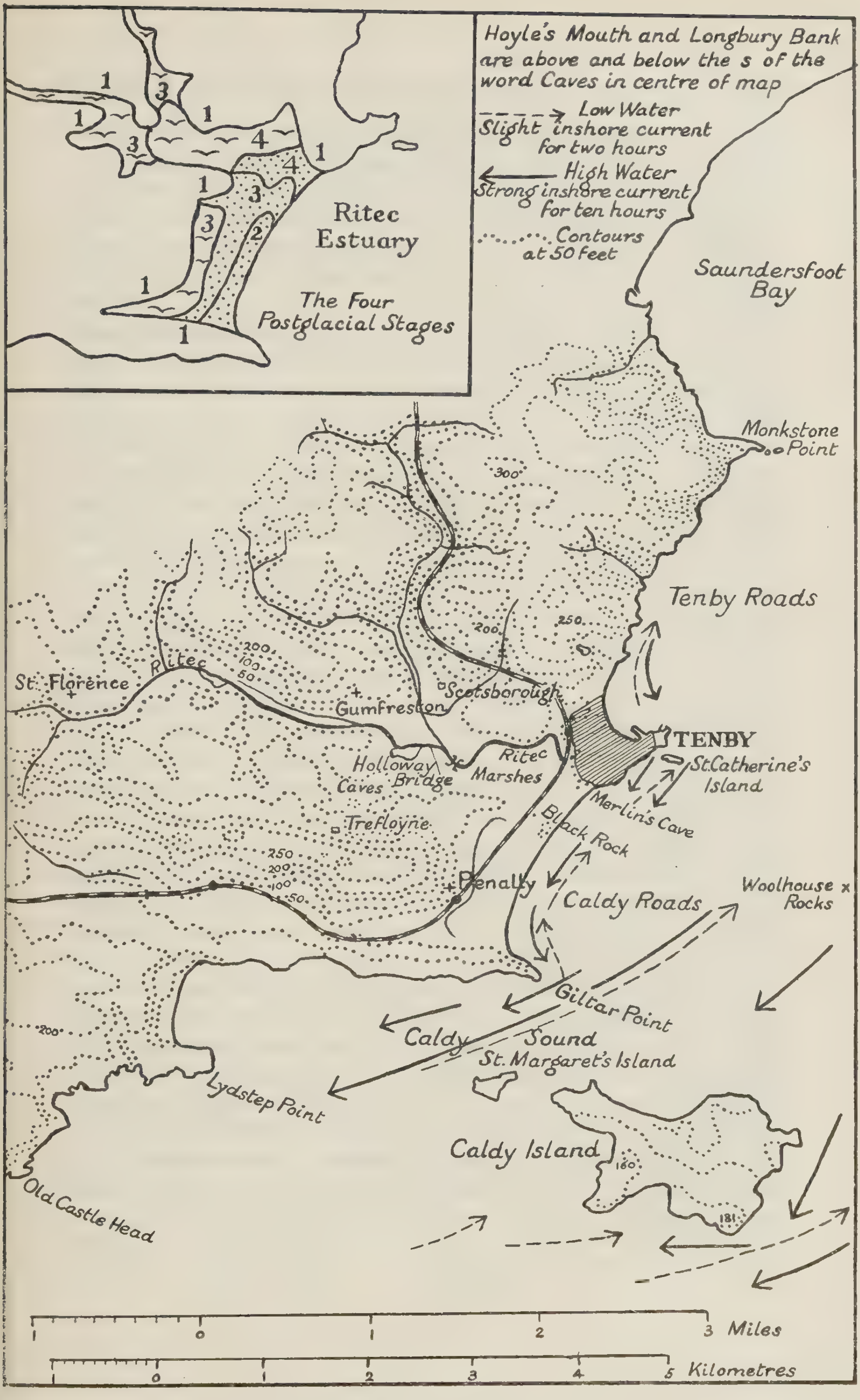
(3) the reconstruction of the physical history of the area.

It is strictly understood that any generalizations that emerge are applicable only to the area under discussion.

THE PRESENTATION OF EVIDENCE

The earliest evidence is geological. There are two caves, Hoyle's Mouth and Longbury Bank, inland, overlooking the Ritec valley and about 50 ft. above sea-level. The evidence for the invasion of these caves by the sea is disputed, but all are agreed that the valley below has been so occupied in recent times. A British Association Report describes it as "up which the tide has till very recently been used to flow." The marine nature of the valley alluvium is demonstrated by the presence of Scrobicularia found (by Mr Leach) just below Hoyle's Mouth. Near this site too a Neolithic or Bronze Age dug-out has been discovered, where it had no doubt rested since the days when the sea ran up to that point.

There follows a long gap. We pass into the period of documentary evidence. In an ecclesiastical document of the eleventh century the



Based upon the Ordnance Survey Map, with the Sanction of the Controller of H.M. Stationery Office

30-2

Ritec is mentioned, and both from the reference to its boundaries and from its not being styled a torrent as the other streams are, it clearly must have been an estuary of considerable width running up to St Florence, a distance of 4 miles. Next in order follows a series of County Maps. The earlier are generally inaccurate, but all agree in showing the estuary. We have a contemporary account of the siege of Trefloyne House in 1643. After it was taken, the *river* prevented the Parliamentary forces from doing more than discharging a few cannon-shot at the Royalists under the Earl of Carberry who, we are told, had "marched out of his stronghold of Tenby with some of his forces and faced ours, keeping the *river* betwixt us." It is very evident that the present streamlet opposite Trefloyne could not have kept back the stout Parliamentarians unless it was very different from what it is now. It must have been a wide estuary in 1643. During the eighteenth century the tidal inlet appears in local maps and prints and has references in local literature. Of these we get in 1748 a large-scale map of the region. Here the mouth of the estuary is shown at low water. In 1832 we get a still larger map. The inlet is clearly shown. It is named Holloway Water. During the course of the nineteenth century the usual references continue, but by 1856 the "Holloway Water" of 1832 has become "Holloway Marsh"; the cause of this we shall see later. About this time too we have two very interesting prints which show the mouth of the now reduced estuary; the two prints are complementary, being taken from opposite sides.

In 1858 appeared the first scientific account of the area. This is a paper on *The change of level in the country near Tenby* read by Mason before the Geological Society of London. We may quote from this paper: "There are those now living who can remember the time when vessels proceeded nearly a mile over what is now pasture-land.... Two posts are still standing upon the Marsh road about a mile and a half from Tenby, which were placed there to mark the depth of the water at spring tides; now, supposing the sea-wall removed, the water would at the present time only reach the posts at the equinoctial tides, and these posts would surely not have been placed there unless the tide had risen at least several feet up them." In 1887 Laws in the *Archaeologia Cambrensis* describes the ruins of what was known as the "Old Quay House" dating, he declares, "not improbably back to the period when ships discharged their cargo at the Old Quay," now inland.

SHORE PROCESSES

(i) *The theoretical explanation*

There are two conflicting theories: that elevation of the strand line has taken place, and that the phenomenon is merely one of silting. Mason's paper already quoted presents evidence in favour of the former view. His points are: (1) In a survey by Capt. Alldridge in 1856 the rocks in that part of the bay opposite to the Ritec valley are fully 2 ft. nearer the surface than they appear in the chart of a survey taken some years previously. (2) Several of the old sailors maintain that the rocks have "grown" nearer the surface and instance one near the western point of St Margaret's Isle, which was formerly safe to pass over even at the lowest tides, but now has risen so high that recently a boat nearly capsized upon it. A smuggler, it is said, many years ago escaped from a revenue-cruiser over the ridge of rocks that at low water connects the islands of Caldy and St Margaret's. The Woolhouse rocks are stated by old men to appear higher than they formerly did. (3) The universality of the occurrence in the Bristol Channel is cited: "Change of level is not confined to the locality; for in a recent number of the *Cambrian Journal* similar changes in other parts of the Bristol Channel are noticed...."

But it would seem that the view presented by Mason is untenable. Relative movement of land and sea has certainly taken place, and its effect upon the present area will be discussed subsequently; but the evidence that such movement has been going on in historical times is very weak. In any case the movement would be so slight as to be masked by the superficial vagaries of sand-drift. Such displacement, if any, would not be susceptible to measurement. Mason's first point can be explained by the oscillations of beach-level which we shall describe later. Moreover, Capt. Alldridge himself was not so sure that there was any discrepancy between his own and a former survey. In a letter he declared: "There is one reason why a difference appears in the depth of water over the rocks in Tenby Bay between my own survey and that of a former Admiralty survey, viz. the standard or low water mark to which my survey was reduced, and I have no knowledge of what Capt. Denham's standard was." Mason's second point can be dismissed. Such tales are common to most coast dwellers and appertain to the psychology of observation. That the ridge connecting St Margaret's Island and that of Caldy was in existence *at least 40 years* previously is shown by an account of Tenby written in 1820, which declares: "St Margaret's Island is disjoined from

Caldy at High Water, but at Spring tides there is a passage over a ledge of rocky ground." The third point is equally unsound. The author himself admits that no trace of any rise of land has yet been found upon the lands adjoining Tenby. The wide distribution of the phenomenon in the Bristol Channel is due to the universality of a process rather than to a general upheaval. Further, the particular examples cited by Mason would point to subsidence rather than to elevation of the land-surface.

We may take it that the phenomenon is one of silting. How did the silting occur?

(ii) *The history of the reclamation*

Carey and Oliver declare in their *Tidal Lands*: "So far as we know salt marshes are never reclaimed unless the sea is banked off either artifically by the construction of sea-walls or naturally by the throwing up of shingle-beaches or sand-dunes." Both methods, natural and artificial, operated in the case of Tenby. Historically, the reclamation of the area is due to two different sets of processes which succeeded one another in point of time; first, there was the construction of banks to keep out the sea, and secondly, there was the enclosure of the river Ritec within a culvert which permitted the accumulation of sand along what was once the river estuary.

The construction of the banks is the older. The most inland (the earliest) cuts the Marsh at Gumfreston. A second starts opposite the ruins of Scotsborough House and extends to a spot near Holloway Bridge. The dates of these two are unknown. The Flemings may have constructed them; if so, they are at least later than 1106. A third bank occupied the line of the present Tenby-Pembroke railway; this was built in 1811 by Sir John Owen. He utilized a natural sand-bank and built a sea-wall extending from Black Rock to a point near the present station. In 1865 the present railway embankment was erected upon the old sea-wall. The stream passed through this by a short stone culvert with flood gates. From here to the sea, a distance of a quarter of a mile, the stream took its own course, wandering with the wind, sometimes in the direction of Giltar Point, at other times in that of St Catharine's Island.

Then followed the second part of the reclamation—successive attempts to enclose the Ritec within a culvert to the sea. In 1876 the short stone culvert over which the railway ran was continued to the old stream mill whence a wooden culvert continued to the sea. This was not satisfactory and often got blocked up by drifting sand. Hence

the present culvert was constructed below sand-level and continued to a point below low-water mark. This is also proving unsatisfactory. Since the building of the wooden culvert in 1876 and especially since the construction of the present work, sand has accumulated enormously. In the cliffs on the north side there was once a cavern, Merlin's Cave, some 30 ft. high and capable of holding a large party. To-day this cave has sanded up and is no longer visible. Its top lies 4 ft. below the present sand-level. In July, 1922 the present walk to the beach was constructed. Already the railings of the lowest slope are half buried in sand. In the same manner has the former bed of the Ritec right back to the railway embankment been sanded in. Tennis courts now exist where not long since the sea used to flow.

The explanation is simple. It is a question of stream erosion. When the Ritec ran free, it "kept its level." All the sand that got blown or drifted into the area of its erosion was carried out to sea again. The shifting of the stream with the wind maintained a wide plane of erosion. When the Ritec was enclosed and made to flow below ground-level, all the debris brought into the locality ceased to be carried out to sea again. Aggradation has been the natural result. The nature of this aggradation will be understood after we have considered the local drift regime of the coast.

(iii) *Present-day shore processes*

The shore consists of a long stretch of sand extending from Tenby to Giltar Head where it is replaced by shingle. This shingle consists of two sets; the ordinary beach, and the storm beach. The latter is of course found at a higher level than that reached by the normal waves. Moreover, it extends further towards Tenby than does the ordinary shingle beach. This point is of some significance as we shall see.

The composition of the shingle beach is as follows: (1) limestone pebbles and boulders predominate; (2) old red sandstone pebbles (often mottled green) are next in abundance; (3) then follows a varied assortment of brown, yellow, and some purple grits, with some black shales; (4) the remainder consists of calcite, flint, igneous rock, and chalk. The probable sources of this material are interesting. Much is the product of local erosion, but some of it is certainly exotic to the area in general. The sources of the foreign material are two in number. Some of it was undoubtedly carried here in ships as ballast. Giltar Head was once quarried for limestone, and the ships used to load up near the point. A record of 1856 declares: "A

sloop moored at the foot of the cliff was loading stone...(which was) shipped to England." The importance of ballast as an element in the composition of shingle beaches is often neglected. The village adjacent to Tenby, Saundersfoot, has a shingle beach, which in the latter half of the last century was of considerable size. Then the village exported comparatively large quantities of coal by water. Since the advent of the railway, the ships (and their ballast) have ceased to come. The shingle beach is wasting away, so much so, that the sea is beginning to eat into the land. This erosion, in revealing old mooring posts, has disclosed an interesting fact, *i.e.* an earlier period of erosion before the existence of the old shingle beach. The shingle beach was but an interlude lasting only as long as coal was exported and ballast received. The second source is that of transported glacial material. The beaches on the other side of Giltar consist almost entirely of green fine-textured igneous rocks largely quartz-felsites, which must have been transported to the area by ice action. Indeed it is probable that the greater part of the material, whatever its primary origin may have been, was immediately derived from submerged glacial deposits, aided by eroded raised beaches.

All this goes to show that the composition of the shingle can give little clue to the present coastal regime. We have next to describe what this regime is for sand and shingle. As to the former, we have seen the sanding up of the Ritec, the filling in of Merlin's Cave, and the covering of the lower slope of the walk to the shore. It will be noticed that these areas lie particularly exposed to the south-west winds; thus the windward part of the slope has been more sanded than the leeward side. With regard to shingle no exact observations extending over a number of years are available, but it is often locally asserted that it is growing in the direction of Tenby. *This is not so.* The limits of the shingle as shown on the Ordnance Survey Map of 1887 are about the same as at the present time. The illusion of an extension of shingle may be produced in two ways, by slight seasonal oscillations in sympathy with storms, and by beach oscillations which reveal underlying shingle. On the sand beach there is a vertical arrangement of particles, the heavier gravel being covered with sand. All heavy material (coins, etc.) gravitate towards this lower level. This gravel may be revealed after on-shore gales and makes it appear that the shingle has been extended laterally. The net result of these remarks is that, while we have proof that the travel of sand is towards Tenby from Giltar, we cannot assert that the travel of shingle under the lee of Giltar Head is in the same direction. In fact the shingle

seems to remain more or less stationary. We have now to account for these movements.

The movement of material on any coast falls into two categories, oscillations of the beach at right angles to the shore, and littoral drift parallel to the shore. The beach on any coast is only a temporary deposit and quickly responds to any disturbances of wind and wave. Observations made by Dr Bryant of Tenby show that the height of the beach oscillates through a range of about 3–4 ft. in sympathy with on- and offshore gales. From this phenomenon arise many inaccuracies of observation. The longshore travel of material is more important. The motion is compounded of two main elements, the action of tidal currents, and the action of wind waves producing beach drift in parabolic curves, together with the dynamic currents attendant upon each element.

Considerable caution must be exercised in accepting charted currents. These generally refer to currents in the offing. The tidal wave advances up the Bristol Channel, and on such a presumption its course is plotted on the published nautical charts. When a bay or headland occurs, however, the flood tide sets into it at the upper end and curling round moves in the opposite direction. Such is the case in Tenby Bay. The *West Coast of England Pilot* declares: "North of Caldy Sound on the west side of Carmarthen Bay, from Giltar Head to Monkstone (to the northward of Tenby), the stream sets along the shore to the north-eastward from one hour before to one hour after low water by the shore, when it turns round and sets south-westward as a sort of eddy, whilst the east-going stream is still running through Caldy Sound, and makes an overfall or race off Giltar point extending about 50 yards." During high water the current along the shore and in the offing sets westwards. Thus for 10 hours you get a strong current towards Giltar, while for 2 hours at low water the tide runs very weakly in the opposite direction. The dominant tidal set is towards Giltar Head.

Consider next the action of wind-waves. Two sets of waves are formed in the bay with different directions of approach: first the ground-swells coming up the Bristol Channel from the south-west but owing to the break-water effect of Caldy and St Margaret's isles tending to approach the shore from the immediate offing at right angles, and secondly the wind-waves approaching from the south-west. Hence there is a projection of water in the direction of their resultant, *i.e.* towards Tenby. This together with the drag of the wind overcomes the effect of the tidal current which is flowing in the

opposite direction. The net result is a drift of sand in the direction of Tenby aided, as we have seen, by direct wind action between tide-marks during low water. But under Giltar Head, owing to the shelter, conditions are different. The wind-waves are weak and only serve to serrate the crests of the ground-swell which approach from the offing. The effect of the south-west waves is at a minimum; that of the ground-sea at a maximum. This ground-sea has two effects. In the first place these waves are always more powerful and exert a greater percussive effect on sea-wall or cliff and the backwash is more destructive to a beach than the ordinary wind-waves. Under the lee of Giltar the sand tends to be washed away by the destructive ground-sea back-wash. This cannot happen on the rest of the coast; for there effects of the ground-swell are subordinate to those of the direct wind-waves. Secondly, as Dr Cornish has pointed out, when a ground-swell reaches the shallows, "the forward motion of the wave is sharp and short and the water is brought back into its former position by a slower motion lasting a longer time," and from this it may happen that "sand will travel seaward, whilst shingle continues to travel shoreward." This seems to be the case under the lee of Giltar. Moreover, the tidal current is stronger towards Giltar and tends to sweep the sand out.

From these considerations we reach the conclusion that, owing to the predominating influence of the ground-sea operating in these two ways and owing to a swifter tidal current, a sand beach is prevented from accumulating under the lee of Giltar. This idea, that the shingle is fed "broadside on" as it were and not by a lateral drift, is favoured by the absence of a grading of pebbles, those at one end being as big as those at the other. The attachment of seaweed (*e.g.* Laminaria) by increasing the buoyancy of the stones, aids this process of broadside feeding. We have noticed that the storm beach extends further towards Tenby than does the ordinary shingle. This is due to the fact that during storms the area of eastward drifting encroaches upon the area of broadside feeding under the lee of Giltar owing to the strength of the wind. This is so, because the stretch of coast protected by Giltar head is reduced; some of the shingle actually begins to travel east with the sand. This is piled up into a storm beach which cannot be worked back during normal conditions.

(iv) *Two main conclusions*

(1) The shingle is chiefly derived from buried glacial deposits. This accounts for the large percentage of igneous material. Ballast is a subsidiary agent.

(2) The distribution of sand and shingle is determined chiefly by the direction of wave-approach rather than by tidal currents. The sand travels eastward and so has filled up the Ritec estuary. The shingle under the lee of Giltar Head is the product of special conditions, and its limits are on the whole stable. The latter conclusion only applies to this particular shore. On the question of long-shore drift a considerable controversy has taken place between the adherents of the wind-wave and tidal-current ideas respectively. It must be recognized that as yet no general rule can be laid down. The direction of drift is the resultant of two variable sets of forces. Each stretch of coast has to be considered on its own merits. Thus in the bay adjacent to that of Tenby, owing to local conditions, the tidal currents are more potent than the action of wind-waves, and so the long-shore drift is in the reverse direction, *i.e.* to the west.

PHYSICAL HISTORY OF THE AREA

It remains to construct a general post-glacial history of the area. All round the Bristol Channel there is evidence in the form of submerged forests, peat levels, and buried river channels that the land stood much higher in relation to the sea than it does now. Then came a period of subsidence which ceased by the beginning of Neolithic time. A reconstruction of our stretch of shore after this subsidence is not difficult. In this bay a bay-bar was formed stretching from Giltar towards Tenby. This bar became the nucleus for the present line of dunes. The area behind the bar silted up. But the tidal river Ritec kept open its own inlet. The fourth stage is that of the present day. This inlet, reclaimed by banks and later by the enclosure of the stream in a culvert, silted up. The present marsh is the remaining relic. The zone of dunes has naturally widened. But there is no evidence to show that the dunes are growing at the present time. The Ordnance Survey records no change between 1887 and 1924.

PROF. J. STANLEY GARDINER congratulated Mr Darby on an interesting study. He commented on the old estuary of Tenby as an embayed valley but yet apparently with cliffs in places as indicated in the photographs. He put in a strong plea for the proper delineation of landslopes along such valleys, including the careful charting of cliffs. He considered it necessary all over the world for human impressions of changes of level along embayments and coasts to be replaced by accurate measurements and photographs from charted spots, which could be available for deduction by all research workers. He asked also for the study of both surface and subsurface currents in such embayments and along the neighbouring coasts.

THE INTERNAL DRAINAGE AREA OF COLLAO

H. HOPE-JONES

Other works: *Apuntes sobre Cailloma. Resumen de las observaciones termométricas tomadas en Cailloma durante siete años consecutivos: Boletin de la Sociedad Geográfica de Lima*, 1903, XIII, pp. 473–480.

San Ignacio, Cailloma: Curvas durante ocho años del aguacero y de las temperaturas: ibid., 1904, XV, p. 468.

Hidrologia (con dos gráficos:—Observatorio de Cailloma: pulgadas de aguacero: Caudal de los ríos Cañete, Pativilca, Chicama, Rímac): ibid. 1922, XXXIX, p. 78.

The Lima Geographical Society was founded in the year 1888, at which time I became a member; since the year 1904 I have had the honour of serving on the Committee. During over 50 years' residence in Peru I have wandered over practically all the territory. The Society has asked me to offer this paper to Section F, trusting that you will find the Internal Drainage Area, known to the Incas as Collao, of sufficient interest.

This area is enclosed by the 66th and 71st Meridians W. and by the 14th and 20th parallels S., the watershed being marked by the following mountains:

Height in metres

Illampu ...	7200	Chipiquina ...	5040
Sajama ...	6546	Orcotunco ...	5010
Illimani ...	6470	Yanaorco ...	4866
Parinacota ...	6376	Quenamari ...	4850
Pomarape ...	6260	El Paso	4816
Huaino-Potosi	6185	Paso Tignamar...	4760
Ananea ...	5934	Capitan	4750
Umuruta ...	5730	Huacuyo ...	4730
Lliscaya ...	5560	Tambo Quemado	4689
Vilcanota ...	5486	Paso Titue ...	4650
Quisiquisini...	5486	Guacollo ...	4608
Chachacomani	5378	Putre	4560
Paquisa ...	5320	Transasa ...	4550
Palomani ...	5300	Paso Huailillas ...	4476
Belen ...	5220	Crucero Alto ...	4470
Aparave ...	5090	Paso Caliente ...	4439
Anocariri ...	5050		

In short, the heights vary from 14,500 ft. to 23,600 ft.

In order to understand the problem presented by this Drainage Area a few words regarding the general geology of Peru will be necessary. The original chain or Cordillera of the Andes is formed of archaean rocks, and the greater part of it has foundered in the

Pacific leaving a few granite hills and islands on the extreme west coast. The country at present occupied by the Andes proper was then an inland sea, out of which several parallel chains have risen, the most recent, which is the present watershed between the Atlantic and the Pacific, being the range furthest to the west facing the Pacific. These existing ranges are built up of sedimentary rocks, very distorted and metamorphosed, with great intrusions and overflows of volcanic origin. There is abundant evidence that the Andes and much of the Peruvian littoral are still rising, as noted by Darwin, Markham, and others. The rivers may be divided into three systems, those flowing to the Pacific, the tributaries of the Amazon, and rivers contributing to Lakes Titicaca and Poopo, these latter having no visible outlet to the sea.

The total area of this basin is 136,672 sq. km.; but, as part of it belongs to Bolivia, we have confined our study to the Lake Titicaca area, which contains 78,266 sq. km. The area of Lake Titicaca itself is 8865 sq. km. The height of the lake above sea-level is variously given by engineers and other observers as from 3806 to 3825 m.; but we can take 12,500 ft. as about correct. The extreme variation in level during 20 years has been 9·5 ft.; but the average annual variation is about 3 ft. The depth runs about 700 to 1000 ft.; but soundings of 1700 ft. have been reported, although we consider these figures doubtful. The temperature of the lake water does not vary much, generally running between 15° and 18° C. No ice is formed on the lake, except at shallow edges from May to August. Shade temperatures in Cailloma, at 14,700 ft., vary between plus 19° and minus 12·5° C.

Records of rainfall have not been kept in the basin; but the writer's pluviometer in Cailloma (50 miles due west, altitude 14,700 ft.) gave as an average of 14 years' observations 27·8 in., say 70 cm. The moisture brought up from the South Atlantic by the trade winds passes over the enormous heights of the Illampu, Sajama, Illimani chain before reaching Cailloma; and the rainfall must be much heavier over the Titicaca basin. For the sake of calculations we have estimated a rainfall of 85 cm., a figure given by some authorities.

The evaporation on the lake surface, taking an average of a two-year record, is 5 mm. daily.

The discharge of the Desaguadero, the only river running out of the lake, varies constantly. The highest recorded discharge is 14,126,400 metric tons in 24 hours, but the average discharge during the year is about 10 per cent., say 16·35 tons per second.

The above estimates would give us the following results:

		Metric tons
Rainfall on basin, 78,266 km.^{2} at M 0·85	=	66,526,100,000
Evaporation on lake, 8865 km.^{2} at M 1·825	=	16,178,625,000
Discharge at 16·35 tons per second	=	515,613,600
Leaving a "surplus" to be accounted for of		49,831,861,400

Taking into consideration the facts that the precipitation is mainly in the form of snow which melts in a few hours of the morning sun and that the slope of the area is very steep, the run-off is larger than that usually calculated in the text-books.

The Desaguadero River runs into Lake Poopo in the second part of this Internal Drainage Area, which we are not studying as it lies in Bolivia. Its course is 425 km., and it loses water all the way by evaporation and percolation. Practically no water runs out of Lake Poopo.

According to tradition, the Inca civilization emanated from the Collao, the Internal Drainage Area of which we are treating. With the scant material in the hands of archaeologists, history is an impossibility; but the imposing pre-Inca ruins of Tiahuanaco, on the borders of Lake Titicaca, prove that this now semi-desert country was once very thickly populated, and that a high grade of civilization was prevalent in Tahuantinsuyo, contemporary with or previous to that of Egypt. Climatic conditions to-day make life very hard in this basin; the elevation of 13,000 ft., and the extreme variations of temperature, impede vegetation. But the "andenes" or hanging gardens, still to be seen, prove that cultivation was previously general; in fact, Sir Clements Markham suggests that, when Tiahuanaco was built, the basin was 5000 ft. lower. You can get badly sunburnt on one side of a house, while the snow lies banked up on the shady side. The present population is probably only 10 per cent. of that previously existing, having notably diminished even since the Spanish conquest.

Two steamers, the *Yavari* and *Yapura* were packed on mules and brought from Arica on the Pacific coast. They were launched on the lake in 1866, and were originally 100-ton ships, with high pressure engines by James Watt, dated 1862. They have since been lengthened and are now 160 tons, single screw, Semi-Diesel motors, 225 H.P. The *Inca* is 700 tons, twin screw, triple expansion, coal fuel. The *Coya* is 450 tons, twin screw, cross compound, oil fuel. The *Inca*, *Coya* and *Yavari* are for passenger and cargo service, while the *Yapura* is used for transport of fuel oil, kerosene, gasolene, and

dynamite. They are all run by the Southern Railways of Peru, a subsidiary of the Peruvian Corporation of London.

In shallow bays large reeds are very plentiful and are utilized by the Indians for the building of boats both large and small, which they use not only for fishing but for the conveyance of merchandise. Even the sails are made of this "totora" or reed-matting. Such boats become water-logged and require hauling up on to the beach from time to time. Winds are very severe and cause a nasty sea, very unsettling even to the stomach of an old salt.

Authorities

The most important of the foregoing data have been collected during 20 years' residence by Mr Thomas A. Corry, Chief Civil Engineer of the Southern Railways of Peru.

For geological data, Prof. Carlos I. Lisson: *Memoria sobre el Mapa Cronológico del Levantamiento de los Andes Peruanos*, Lima, 1924, 36 pp. *Como se generó el Suelo Peruano: Boletin de la Sociedad Geológica del Perú*, Lima, 1925, I, pp. 97–126.

Soundings made by the French Mission of 1903.

Plan and profile of the Desaguadero River by Bergelund.

The flora and fauna of the basin are given in a monograph of the Department of Puno by Emilio Romero, pp. 233–254.

PROF. J. STANLEY GARDINER thanked the reader for a most interesting communication and referred to the important work of the Lima Geographical Society in establishing a centre for research. The Society has laid truly important foundations and has now envisaged for us the basin of which Lake Titicaca forms part. It is a peculiarly interesting basin from its topography which must have profoundly affected and governed its animal life. He would expect its investigation to throw much light on the whole South American faunal province, while it is an area where ancestors of the larger extinct mammalian groups (*Condylarthra*) might well be found as well as of those that still exist.

LE CHEMIN DE FER DE MONTAGNE DE BERGEN À OSLO

PROF. GEORGES PARMENTIER

See *La Géographie*, Paris, 1928, L, pp. 92–102.

Résumé

La ligne de Bergen à Oslo (492 km.), commencée en 1878, reprise en 1894, et continuée ensuite sans interruption, fut ouverte au trafic en 1909 après quinze ans de travaux formidables. Elle fut empruntée en

1914 par les Alliés: c'était alors la seule route possible pour les communications avec la Russie.

Les difficultés de la construction se firent naturellement sentir dans la partie montagneuse sur une longueur de 100 km., à une altitude supérieure à 1000 m., à plus de 300 m. au-dessus de la végétation arborifère, en plein désert.

Après quinze années de travaux préparatoires concernant l'étude de l'épaisseur des neiges, l'orientation de la voie, sa déclivité, et la création des deux routes de transport de Voss à Opset et de la ferme de Kaardal (vallée de Flaam) à Opset, on entreprit la construction proprement dite.

Cette construction se compose de différentes œuvres d'art:

(1) *Les entailles* dont la plus grande a un volume de 300,000 mc. Hauteur de la coupure 21 m., largeur du sommet 70–100 m.

(2) *Les ponts* de Hönefos, sur la rivière Bœgna, 215 m., 8 arches; et de Svenskerud d'une seule arche, 44 m.

(3) *Les tunnels*, au nombre de 178, creusés dans la roche vive, 119 sur le versant ouest, 58 sur le versant est; longueur totale des tunnels, 50 km.

(4) *Les paraneiges* destinés à protéger la ligne contre l'assaut des neiges.

La pose des rails ne demanda pas moins de 3 années (1906–1909) de travaux interrompus seulement par la rigueur des hivers et l'amoncellement des neiges. Sur une longueur de 100 km. la pose de rails avança régulièrement de 1050 m. par jour.

La ligne fut inaugurée en 1909 en présence du Roi Oscar II.

DISTRIBUTION OF CULTIVATED LAND IN JAPAN PROPER

K. UCHIDA

Abstract

The cultivated land in Japan Proper (its area is 381,250 sq. km. or 56·56 per cent. of the whole of Japan) has an area of 6,001,000 hectares. This is only 15·25 per cent. of Japan Proper, but supports farmers to the extent of 84·24 per cent. of the inhabitants (55,848,000) or 50 per cent. of the families of Japan Proper (according to the first census in 1920).

Although fertile lands are cultivated up to the height of 2000 m.

and a slope of 30°, most of the cultivated lands are on low plains near the sea. There are also a few in valleys and basins inland.

Since rice fields require much more water, flat ground, fertile soil, and higher temperatures than other farms, their altitude limit is lower than that of other farms, and becomes gradually lower still as we pass from the south-western districts (in Kyushu it is about 1300 m.) to the north-eastern districts (in Hokkaido it is about 200 m.). However, on some coastal plains of the Nippon Kai (Japan Sea) drainage basin of Honshu, and in some inland basins of Honshu, it is relatively somewhat higher than on the Pacific coastal plains, because in those regions the temperature in the daytime is relatively higher in summer than in the others. Some rice fields of the south-western regions are utilized also as farms in winter; but there are no such fields in the north-eastern regions on account of low temperatures.

Rice fields can support more farmers than other farms can. Therefore farmers like to cultivate rice fields as much as possible; and we can see that the total area of rice fields (it is 3,116,000 hectares or 52·7 per cent. of the whole cultivated land) is larger than that of other farms, most of which have some conditions unsuitable for rice planting.

We can deduce also the relative density of population from the map of the distribution of cultivated land in Japan.

23 JULY

PRESENTATION OF NEW VOLUMES OF SCIENTIFIC REPORTS OF THE DE FILIPPI EXPEDITION IN THE HIMALAYAS, KARAKORAM, AND CHINESE TURKISTAN (1913–14)

CAV. DR FILIPPO DE FILIPPI, K.C.I.E.

Other works: *Storia della Spedizione Scientifica Italiana nel Himàlaia Caracorùm e Turchestàn Cinese* (1913–14): Bologna, 1924, 541 pp.

La Spedizione de Filippi nell' Asia Centrale: Bollettino della Reale Società Geografica, Roma, 1914, Ser. v, Vol. III, pp. 84–7, 663–9, 1307–14; Vol. IV, pp. 109–14, 354–64.

Spedizione scientifica italiana in India ed in Asia Centrale negli anni 1913–14: *ibid.* 1915, Ser. v, Vol. IV, pp. 645–85.

Expedition to the Karakoram and Central Asia 1913–14: *Geographical Journal*, 1915, XLVI, pp. 85–105.

At the International Geographical Congress in Cairo Prof. Giotto Dainelli presented three volumes edited by him of the Second Series of Reports, which contain the geological and geographical results of

the Expedition. One of them (Ser. II, Vol. III, with plates) was devoted to the glaciation of the quaternary; another (Ser. II, Vol. VIII) to the anthropo-geographical conditions of the regions traversed; and the last (Ser. II, Vol. IX), to the cultural life of the inhabitants and to the analysis of the many anthropological measurements taken by Prof. Dainelli.

To-day I have the honour to present, on behalf of Prof. Dainelli, two more volumes of the same Series. One of them (Ser. II, Vol. VI) contains descriptions and illustrations of the secondary and tertiary fossils (of the Triassic, Jurassic, Cretaceous and Eocene), collected between the central Himalayas and the Karakoram. Needless to say, I have no intention of dwelling on the contents of this volume, which deals almost entirely with palaeontology. I shall only mention that nearly all the fossils described represent finds entirely new to the region and allow the establishment of facts hitherto unknown in the geological history of the great mountain range, making it possible to fix some palaeogeographical features of noteworthy interest. These conclusions will be discussed in a volume devoted to the geological conditions of these periods, to which Prof. Dainelli is now turning his attention. A volume dealing with the fossils of the palaeozoic is also in preparation (Ser. II, Vol. V).

The second of the two volumes presented to-day (Ser. II, Vol. IV) is strictly geographical. It is concerned with the present physical conditions, and the greater part of it is devoted to the study of the glaciers and the snow-limit. The researches are mostly limited to the southern slopes of the Karakoram; for the knowledge we possess of the glaciers flowing from the northern slopes of both the Karakoram and the western Himalayas is still very incomplete and limited to those of Nanga Parbat and the Nun Kun. However, the author has not failed (when the occasion seemed suitable) to institute comparisons with conditions obtaining in the mountain districts outside of those directly observed by him and especially considered in this volume.

It opens with a sketch-catalogue of the glaciers of the Karakoram. I say "sketch," because, in comparison with the infinite number of existing glaciers, those of which we have any description and information seem very few indeed; and they are nearly always those of the greatest size, that is to say, they belong to a particular type among the many types of glaciers that could be distinguished in this as in other great mountain chains. However, the author has summarized from former explorations, and from his own, what we know of the topographical conditions of the glaciers of the Karakoram; and he

has been able to draw some conclusions of a general character, especially in regard to the different intensity of glaciation in different sections of the range. A map, which is probably a new attempt to express the variations of the phenomenon cartographically, brings some interesting facts to light.

Some of these facts demonstrate an evident connection with the variation of the snow-limit. For this reason the second part of the volume is devoted to a study of the snow-line. It is preceded by some chapters of an introductory and meteorological nature, relating and discussing the various systems proposed for ascertaining the snow-limit, the sources of error contained in them, and the way to avoid them. These chapters were written by Olinto Marinelli, our lamented colleague and friend. The next part of the volume is analytical, leading to an estimation of the limit of the snows both in the western Himalayas and in the Karakoram. The result of the long and critical work of analysis of all obtainable data is embodied in a map of the snow-limit, in which the details of the phenomenon are clearly shown. The essential and most important facts are also, of course, illustrated and explained in the text, in which a connection is established between this important physical limit and the biological and anthropo-geographical conditions which the author has studied in another volume, that is to say, the distribution of trees and shrubs, of agriculture, and of human settlements. A comparison is also made with the snow-limit estimated by the author for the period of the greatest quaternary glacier-expansion. What seem particularly interesting are the observations in regard to the variations of the actual limit compared with the variations of the quaternary limit.

The problem of the snow-limit having been thoroughly investigated, in a third part of the volume the characteristics of the glaciers of the Karakoram are discussed at length. Here too some introductory chapters of a general nature, on the various types of glaciers observed here and also in other regions, are due to the special knowledge of the subject possessed by Olinto Marinelli. There follows an exposition of the principal characteristics of the glaciers of the Karakoram, their alimentation, ablation, velocity, morphology, snouts, moraines, and lakes, comparing the observations of predecessors with those of Dainelli, who already possessed a long experience in Alpine problems. Without entering into details I will merely say that interesting morphological characteristics are put in evidence, and explanations, in great part new, are given of the forms as also of the economy of the largest glaciers in the chain.

The last part of the volume is concerned with some particular physical phenomena typical of the region: such as frozen soil, valley ice, thermal springs, mud streams, and forms due to meteorological disintegration and to water-action, etc.

Prof. Dainelli has given to this volume the same synthetic and monographical character that he gave to the others. He would be the last to claim that nothing escaped him of what had already been observed and written on the subjects discussed; but certainly the little that may have escaped him cannot alter the picture he has given us of glacial phenomena to-day in the Karakoram.

To the above-mentioned volumes I add one of the First Series (Ser. 1, Vol. 1) containing the reports of the astronomical-geodetic work of the Expedition by Admiral Alessio, Prof. Abetti, and Mr Spranger. Col. H. Wood has also given a report on this part of the Expedition's work in *Explorations in the Eastern Kara-Koram and the Upper Yārkand Valley*, published by the Survey of India in 1922. The observations were carried out with the object of determining the co-ordinates of the fundamental points and, where possible, the deviation from the vertical. The latitudes were taken by the Horrebow-Talcott method, using a zenithal telescope of 63 mm. aperture, and values obtained for eleven stations in Baltistan, Ladak, the Karakoram range, and Chinese Turkistan with a mean error of $\pm$ 0″ 25. For the longitudes the local time was determined by Abetti and Alessio with a transit instrument of 65 mm. aperture, checked by a series of marine and pocket chronometers and especially by wireless time-signals transmitted by the Lahore station and received simultaneously at the base stations of Dehra Dun and at the station occupied by the Expedition. The longitudes were obtained for eight of the stations of which the latitude had been determined, with a mean error of about $\pm$ 0″ 03. In seven of these stations it was possible, by comparing the astronomical co-ordinates with the geodetic, to obtain the deviation from the vertical.

Determinations of position were also made with the instruments and methods of nautical astronomy in places—as for instance the Rimu (Remo) Glacier—where it was not possible to carry the above-mentioned instruments. Geodetic and topographical operations were carried out by the two groups of observers, Alessio-Abetti and Wood-Spranger, with the methods commonly in use, for the triangulation and the survey of the Depsang Plateau, of the eastern Karakoram watershed, and especially of the Rimu Glacier, the source of the Shyok River on the southern and of the Yarkand on the northern

slopes. And also, with the help of the rapid photogrammetric method entrusted to Major Antilli, the detailed topography of zones was obtained, where it was needed for the measurements of gravity, as for example the basin of Skardu in Baltistan, that of Leh in Ladak, the Depsang Plateau, etc.

Particular care was given by Abetti and Alessio and by Venturi Ginori to the determination of altitudes by a series of mercurial barometers and by a series of hypsometers, which also made a comparative study of the two methods possible.

The other two volumes of the First Series, which are in process of being printed, will contain the results of the gravimetrical and magnetic work and the meteorological observations.

SIR GERALD LENOX-CONYNGHAM said that he was glad to have an opportunity of bearing witness to the admirable character of the Expedition led by Dr de Filippi. It had been his privilege to receive two members of the Expedition at Dehra Dun, the headquarters of the Trigonometrical Survey of India, and he had been much impressed by the excellence of the organization and equipment and by the scientific attainments of the personnel. He particularly desired to speak of the excellent spirit which pervaded the Expedition. It was clear that their only wish was to co-operate with others and to add to knowledge. If any of the results of their predecessors had to be criticized, it was done with the most meticulous, he might almost say reverent, care, and no change was made until the need for revision had been clearly established. The contribution made by the Expedition to knowledge was one of great value and the results obtained were admirably set out in the sumptuous volumes which Dr de Filippi had just presented.

M. LE PROF. E. DE MARGERIE fait ressortir l'intérêt exceptionnel des publications de la Mission de Filippi non seulement pour la connaissance de l'Himalaya et du Karakoram mais aussi pour l'étude des chaînes de montagnes en général. Il adresse au nom de tous les géographes présents ses félicitations particulières à M. le Prof. G. Dainelli dont l'activité dans les domaines les plus divers est un objet de surprise pour les spécialistes de chacune des branches de la Science. Dr de Filippi et ses collaborateurs ont brillamment suivi une tradition qui remonte en Italie jusqu'aux voyages de Marco Polo; et il convient de les remercier chaleureusement de leurs efforts.

CERTAIN ASPECTS OF THE GOLD COAST

SIR ALBERT E. KITSON, C.M.G., C.B.E.

Other work: *The Gold Coast: Some Considerations of its Structure, People, and Natural History: Geographical Journal*, 1916, XLVIII, pp. 369–92.

Abstract

A brief description of the geographical and geological divisions, the rainfall, vegetation, soil, and water-supply, and their influence on the distribution of the people.

The effect of human invasions, and the relation of the trade routes from the hinterland and beyond it to the Colony and Ashanti.

The influence of prevailing winds and the Guinea current.

The relation between the geography, geology, and natural resources of the country and the industries already established and of some of those that can be established through the development of the country by railways and roads.

MR W. F. MINDHAM thanked Sir Albert Kitson on behalf of the Gold Coast Survey Department and of Mr Clendinning the Surveyor-General for his kind references to the Department. He would like to know whether the mineralized zone extended into the Ivory Coast on the west as it appeared to do and whether the French had done any geological survey on their side.

OROGRAPHY OF THE SPANISH BASQUE COUNTRY

PROF. P. ARANEGUI

See *Orografia de la Región Vasco-Cantábrica: Revista Internacional de los Estudios Vascos*, San Sebastián, 1929, Tomo XX, pp. 6–12. (In Spanish, with map, profile, and 10 photographs.)

Other works: see p. 492.

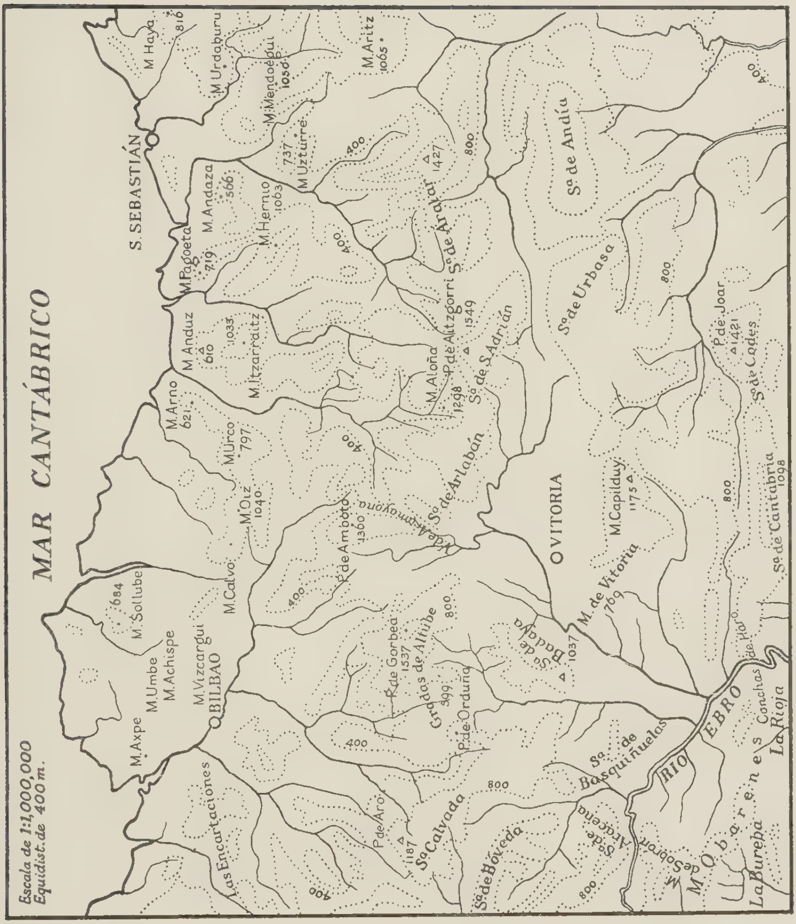
The figures 1 to 7 in brackets refer to the list of works, p. 492.

The mountains of the Spanish Basque country are not arranged in clear, defined lines. Generally the relief is extremely uneven; and to establish the relations between the different mountains of the country is a complicated and embarrassing task that only with the help of the geology and of the tectonics can be accomplished. First, I shall point out briefly the main mountain lines in the country, and afterwards I shall enquire into the causes of such an arrangement of the relief in relation to the geological constitution and tectonic features.

E. Hernández-Pacheco (6, p. 61) and J. Dantín (3, p. 83) have already noted that the mountain culminations of the Basque Country reach a lower altitude than those of the neighbouring ridges; likewise it has been established (4, pp. 197–207) that the Basque Mountains have to be considered as forming a part of the northern orographical system; but discrepancies crop up when we have to decide if these mountains belong to the Pyrenees or to the Cantabrian chain, or if they form an isolated mountain group, or if the more southerly of them belong to the Iberian system.

The foregoing words show the orographical interest that this country presents. The problem, which has been specially studied since 1912 (3, 4, 6), is chiefly of a tectonic nature and will be dis-

P. de Aitzgorri
1549
P. de Joar
1421
M. Itzarraitz
1033
Sª de Urbasa
Mar Cantábrico
N
Escala Vertical 1:100,000
S



MAR CANTÁBRICO
Escala de 1:1,000,000
Equidist. de 400 m.
S. SEBASTIÁN
BILBAO
VITORIA
M. Haya
816
M. Urdaburu
M. Mendoegui
1050
M. Aritz
1065
M. Uzturre
737
M. Andaza
566
M. Hernio
1063
M. Pagoeta
719
M. Anduz
610
M. Itzarraitz
1033
M. Arno
621
M. Urco
797
M. Oiz
1040
M. Calvo
M. Sollube
684
M. Umbe
M. Achispe
M. Vizcargui
M. Axpe
Las Encartaciones
Sª de Andía
Sª de Aralar
1427
Sª de Urbasa
P. de Aitzgorri
1549
M. Aloña
1298
Sª de S. Adrián
Sª de Arlabán
P. de Amboto
1350
P. de Gorbea
1537
P. de Orduña
Sª de Badaya
1037
M. Capilduy
1175
M. de Vitoria
769
P. de Joar
1421
Sª de Codes
Sª de Cantabria
1098
Sª de Basquiñuelas
Sª Calvada
P. de Aro
1187
Sª de Bóveda
RIO EBRO
Conchas de Haro
La Rioja
La Bureba

cussed further on; but first it must be established that the Basque Mountains belong *totally* to the northern system, including the Obarenes Mountains, which constitute in this country the most southerly mountain ridge of the said northern or Pyrenean system, as I have previously proved (2). Within the Pyrenean system undoubtedly the Basque Mountains occur in a depressed zone, which separates the isthmian Pyrenees from the Cantabrian chain; and thus is justified the name of "Basque Depression" that has been employed for describing this country. However, such a depression is no reason for separating the Pyrenees from the Cantabrian chain, both being by their origin, constitution, and general direction in clear continuity the one with the other. This depression is precisely where the connection of the northern system with the Iberian system takes place. Nevertheless, although this connection is in several ways very strongly emphasized, the plateaus of La Bureba and La Rioja make a separation between the two systems (2).

Beginning the descriptive study of the Basque Mountains in the extreme west of the country, we find the first thing that calls for remark is the territory of Las Encartaciones, which occupies the more westerly part of Vizcaya adjacent to the Province of Santander. The curious orographical arrangement of this small territory has been already more or less commented on by certain observers; the general tendency of the Basque ridges to a N.W.–S.E. alignment is specially noticeable in Las Encartaciones, which consist of a series of mountains directed N.W.–S.E. and separated by small green valleys sprinkled with frequent cottages. The northern slopes of these mountains are much steeper than the southern. The same direction is taken by the Sierra Salvada, lying to the south-east of Las Encartaciones (1); this might be considered a continuation of Las Encartaciones, if the Ordunte Mountains and the Mena Valley were not in between with a direction exactly at right angles to that of those mountains. Among the heights bordering the Mena Valley may be mentioned Ocejo (1909 m.), Peña Mayor (981 m.) and the Igaña Rock (1256 m.), as important peaks. In the Sierra Salvada (1), which have an average altitude of 935 m., the most prominent summit is the Aro Rock (1187 m.); mention may also be made of the Orduña Rock (886 m.) which occupies a strategical position. The north-eastern slope of the Sierra Salvada is very steep, while the opposite is a much gentler slope. The tendency to the direction N.W.–S.E. is still seen in the so-called Gradas de Altube (599 m.), a hill group where the northern slopes are much steeper than the southern as in Las Encartaciones and

the Sierra Salvada. The same thing occurs in the Sierra de Bóveda, which rises to the south of the Sierra Salvada.

The Oiz Mountain (1040 m.) is the most elevated summit of a group, also directed N.W.–S.E., situated in the eastern part of the Province of Vizcaya. It belongs to a mountain ridge which rises majestically overlooking the Cantabrian Sea with a direction W.N.W.–E.S.E., parallel with this part of the coast. This ridge is marked, from west to east, by the peaks Axpe, Umbe, Achispe, Arechavalaga, Vizcargui, Calvo, Oiz (1040 m.), Urco (797 m.), Max (772 m.), Itzarraitz (1033 m.), Hernio (1063 m.) and Uzturre (737 m.). Other mountains to the north of that ridge, several of them with a direction N.W.–S.E., constitute buttresses, the lowest spurs of which project into the sea, thus causing the very irregularly notched shore-line. I may mention the chief of them: Sollube (684 m.), Arno (621 m.), Anduz (610 m.), Pagoeta (719 m.), Andaza (566 m.), Adarra (672 m.) and Mendoegui (1050 m.). Even further to the north, on the boundary of the Provinces of Guipúzcoa and Navarre, Urdaburu (638 m.) and Haya (816 m.) are noteworthy eminences.

The highest summits of the Basque country are the Aitzgorri (1549 m.) Rock and Gorbea (1537 m.) Rock, both belonging to a mountain ridge which begins on the west with the Sierra Salvada, to which allusion has already been made, and continues with the Gorbea Rock, the latter being connected with the Sierra Salvada by the above-mentioned Gradas de Altube. East of the Gorbea Rock, the Aitzgorri Rock appears connected with it by the Sierras de Arlabán, Elguea, Aranzazu, and San Adrián, though between the Sierra de Arlabán and the Gorbea Rock is the renowned Aramayona Valley, the Amboto Rock (1360 m.) forming in this part a mass projecting to the north of the ridge. From the Aitzgorri Rock starts, moreover, a branch to the north-west which ends with the Aloña Mountain (1298 m.). In the whole ridge the southern slopes are much smoother than the northern—a characteristic specially accentuated in the Aitzgorri and Gorbea Rocks, which are much more imposing in aspect observed from the north than from the south. Connected with the Gorbea Rock, though with the very different direction N.N.E.–S.S.W., rises to the south the Sierra de Badaya (1037 m.) with mild aspect and smooth slopes when viewed from the east but with a bold sheer cliff if it is looked at from the west. The Sierra de Aralar (1229 m.) forms the boundary between the Provinces of Guipúzcoa and Navarre and is continued eastwards by the Aritz Mountain (1065 m.).

South of all the above-mentioned mountains and with a general direction W.–E. occurs another mountain ridge which, beginning on the west with the Sierra de Basquiñuelas, continues eastwards with that of Tuyo, reaching the Vitoria Mountains (769 m.), where the culminating peak of Zaldiarán overtops the 900 m. contour-line. East of the Vitoria Mountains runs the ridge with the Capilduy Mountain (1175 m.); and, finally, the Sierras de Urbasa and Andía, with altitudes between 850 m. and 1050 m., constitute the east end of this ridge, which, as may be observed, presents a general altitude lower than that of the previously mentioned more northerly mountains. In the mountains of this ridge also it may be noticed that the northern slopes are much steeper than the southern, as in the neighbouring mountains already described.

The most southerly mountain ridge of the country is formed by the Obarenes Mountains (2), which begin on the west with the Mesa de Oña and end with Las Conchas de Haro, its general direction being W.N.W.–E.S.E. Lying to the north and connected with the Obarenes the Sobrón Mountains spread out in a N.N.W.–S.S.E. direction, forming a mighty buttress, which is continued by the Sierras de Aracena (Villafría Rock, 948 m.) and Peñagobia (Gobia Rock, 1070 m.) (1). East of the Obarenes the Sierras de Toloño (1268 m.), Cantabria (1098 m.), and Codes (Joar Rock, 1421 m.) form a row of great heights separating the Basque country from another much lower and flatter which spreads out to the south and is known by the name of La Rioja. In the western part this zone is called La Bureba; the barrier of the Obarenes separates it from the Basque country.

Of course, the orographical scheme that has just been described does not include every mountain of the Basque country, but only the highest and those, not so high, that have nevertheless importance on account of forming a part of the main mountain ridges and thus help to supply an easier synthetical view of the Basque country relief. Besides the heights mentioned, many others forming buttresses or spurs or simply isolated peaks of small altitude give to the country the labyrinthine aspect offered to the traveller who passes quickly across it; the beauty, ruggedness, and peculiar charm of the Basque country are greatly due to that aspect. A rational comprehension of such an uneven and suggestive relief has been reached only with the help of the stratigraphic and tectonic data and by the careful observation and precise study of various persistent observers.

We have established, then, as a general characteristic of the orography of the so-called "Basque Depression" that it exhibits four

main more or less parallel mountain ridges with general directions W.–E. or W.N.W.–E.S.E. and with the northern slopes much steeper than the southern. One of these ridges reaches a general altitude higher than the others, which descend from the highest northwards and southwards like colossal steps leading north to the Cantabrian Sea and south to the Ebro valley. The regularity which these four mountain ridges show in the Basque country is lost on its western and eastern borders; we have noticed Las Encartaciones of Vizcaya and the rugged arrangement of the mountains in north-east Guipúzcoa and in Navarre. To the west a clear tendency to the direction N.W.–S.E. appears; to the east, on the contrary, the pronounced direction of the mountains is S.W.–N.E. All these tendencies are reflected in the shore line.

The orography of the Spanish Basque country being considered as four parallel mountain ridges, the geological arrangement of the various formations is found to agree closely with it. The highest ridge coincides more or less with the northern edge of an upper cretaceous belt, while the lower cretaceous strata spread out to the north until those of the upper cretaceous again appear on them, forming another belt which reaches great altitudes, especially at its northern junction with the lower cretaceous marked by the most northerly ridge. The Vitoria Mountains and Sierras de Urbasa and de Andía are formed by palaeogene strata, which overlie the cretaceous conformably. The summit line of this ridge coincides with the northern edge of the palaeogene formation. Finally, the Obarenes ridge is formed by a narrow upper cretaceous belt (2), which is contiguous on the north and south with tertiary deposits.

All the above-mentioned belts are arranged more or less parallel with one another, and of course their general direction coincides exactly with that of the respective mountain ridges, thus emphasizing the close relation existing between the orography and the geology in this country, especially in view of the fact that at the very spot, where the direction of the folds changes or strata of different ages adjoin, there orographic disturbances are produced, reflecting exactly the geological conditions. The first of the above-mentioned causes, *i.e.* the change in the direction of the folds, produces Las Encartaciones of Vizcaya, the orientation of which does not agree, as I have explained, with that of the Basque ridges. Likewise the rugged arrangement of the mountains in north-east Guipúzcoa and in Navarre is explained by the presence in that part of primary deposits and of

eruptive rocks such as granite, which indicate the geological characteristics of the Pyrenees, these mountains, particularly the Haya granitic mass, being but the west end of the Pyrenean chain.

The fact that the northern slopes of the Basque Mountains are generally steeper than the southern is also explained by the stratigraphical arrangement, the general inclination of the strata being towards the south. The southern slopes have, therefore, the same inclination as the strata of which they are formed, 30°–40°, while the northern display more or less steep escarpments in accordance with the general laws of erosion in sloping strata, independently of the tectonic accidents that in many places occur and contribute to the same result.

The Basque Mountains owe their uprising to the so-called Pyrenean movements (5), which took place during palaeogene times. The general direction of the folds is W.N.W.–E.S.E., like that of the mountain ridges. The Haya granitic mass constitutes the only instance of Hercynian movements in the country.

LIST OF WORKS REFERRED TO

(1) Aranegui, P. *La cuenca del rio Omecillo: Revista Internacional de los Estudios Vascos.* San Sebastián, 1926, XVII, pp. 437–52.
(2) —— *Los montes Obarenes: Asociación Española para el Progreso de las Ciencias, Congreso de Cádiz.* Madrid, 1928, VI, *Ciencias Naturales*, pp. 57–80.
(3) Dantín, J. *Resumen fisiográfico de la Península Ibérica: Trabajos del Museo de Ciencias Naturales.* Madrid, 1912, no. 9, con 55 grabados intercalados.
(4) Dirección general del Instituto Geográfico y Estadístico. *Reseña Geográfica y Estadística de España.* Madrid, 1912, I.
(5) Haug, E. *Traité de Géologie.* Paris, 1920, p. 1571.
(6) Hernández-Pacheco, E. *Ensayo de síntesis geológica del Norte de la Península Ibérica: Trabajos del Museo de Ciencias Naturales.* Madrid, 1912, no. 7, con 33 grabados intercalados.
(7) Instituto Geográfico. *Mapa de España*, en escala de 1 : 500,000.

24 JULY

RESEARCH AND EDUCATIONAL WORK IN A GRADUATE SCHOOL OF GEOGRAPHY

PROF. WALLACE W. ATWOOD

Other works: *Geography in America: The Geographical Review*, NewYork, 1919, VII, pp. 36–43.

Geography and World Relations: The Journal of Geography, Chicago, 1922, XXI, pp. 81–9.

In the industrial world scientific research has demonstrated its efficiency, and we have come to recognize that we must keep our eyes on the laboratory men if we would keep abreast of the times. Just as

certainly as the physicists, chemists, and engineers are serving humanity, so also do those scholars who take for their field of research the problems of land utilization and the study of those environmental factors which profoundly influence the economic conditions of a people and in the end their happiness. Each nation in the world should maintain an institution endowed and equipped for geographical research and the training of research workers. In each of the larger nations several such institutions should be maintained.

As the pressure upon the land due to the ever increasing population of the earth becomes greater, it is more and more evident that environmental conditions have a greater and greater influence upon the activities of people. We do not conquer nature; we learn to adapt ourselves more intelligently to the conditions provided for us. The demand for more food-crops has displaced pastures from the more productive soils and likewise pressed the forests off the good soils on to the cold, humid, sandy, or stony lands of the continents. The individual who seeks to bring more land under cultivation will discover that all the better lands of the earth have been appropriated. He must turn to the next best lands that are available. It may be that he will turn to a semi-arid land and pay the cost of irrigation, or he may turn to a wet land and pay the cost of drainage. He may turn to an infertile soil which has not yet attracted a farmer and pay the cost of enriching that soil so that he may produce crops. He may go farther from the lines of transport and find it necessary to build his own road, or he may increase his distance from the market so much that his freight-rates are increased. It is clear that before making his choice, he should be conscious of all the opportunities before him and take into consideration all the geographical and economic factors that affect his problem. He will find it important to adjust himself more carefully to the conditions which nature and man have imposed than did his predecessor who found an abundance of rich well-watered soils near to markets or near to good lines of transport. Competition is certain to become keener and desirable parking-space more limited; and therefore it is clear that man must adjust himself more and more carefully and more and more intelligently to the natural environmental conditions.

The day has come when the questions of land utilization involve the consideration of competing lands in distant parts of the world and of present and future means of transport between the complementary geographical regions. When the surplus products of a farmer enter the world-market, the prices of his products are determined by

the competition which he meets from all sections of the world from which similar crops are contributed to the world-market. Geographical research should precede the utilization of the pioneer lands of the earth. The development of land policies by governments, which have appropriated lands to be assigned to pioneer settlers, should be based upon geographical research in the field. The quantitative influence of degrees of relief, of varying soil conditions, and of varying rainfall conditions upon land utilization, all open up great vistas of research which should be supported and promoted by an institution endowed and established for geographical research. Public utility corporations and many private industrial houses are coming to recognize the importance of economic surveys that are essentially geographical. The potential population-carrying capacities of localities to be served by public utility corporations are of vital significance in laying out the plans for such service. The sources and distribution of power are significant in forecasting the industrial development of a community. The present and possible future lines of transport are important in all problems of commerce. There is scarcely a phase of our modern economic life that does not offer to the field worker in modern human geography an attractive research problem and an opportunity to be of real service to a community.

An institution for geographical research will require the services of a group of specialists. Each one in the group must make himself an expert in some phase of geographical study or in some well defined region of the earth. There will be need for those who are trained to do exploratory work. Among them there must be well trained surveyors, who are ready to prepare topographic maps of the regions visited. Specialists in the interpretation of the physical features of the landscape, in the classification of soils and vegetation, in the study of minerals, fuels, and waterpower, must be identified with a field party sent out to do geographical work. Careful climatological studies must also accompany the field studies. In addition to those who are distinctly geographers there should be on the staff economists interested in land economics and in the economic problems that arise in the development of foreign trade. Geographers need to check their conclusions with those of the economist working on similar problems. It is highly desirable also that such an organization should retain the services of a specialist in international relations. Geographical studies must not be limited or in any way handicapped by political boundary lines; and yet the human factor and many of the economic considerations demand that the student of geography should be conversant with

the commercial and treaty relations between the various nations of the world. All members of the staff must be free for a part of the time and so subsidized that they can pursue field studies in different sections of the world. They must come into the seminar or conference with first-hand authoritative knowledge of the regions of the world of which they are speaking. It is highly desirable, after each period of field investigation, that they should have a programme which will permit them to work up their results and prepare some of them for publication.

Such an organization has the opportunity of serving the educational institutions of the country in which it is located, the great industrial and commercial houses, especially those engaged in foreign trade, the educational publishing houses, societies that are promoting scientific exploration, the national weather bureaus, and the governmental and private organizations interested in economic surveys. The geographical profession needs recruits; and advanced students who have had good preliminary training in the various fields of geography should be welcomed in an institution established for the promotion of geographical knowledge. A small group of advanced students gives a real inspiration to those who are promoting research work, and they may serve also during their period of study as able assistants. They may profit more by being intimately associated with a more mature investigator and assisting him in his work than through set lecture courses. The atmosphere of a seminar or a conference among colleagues is the ideal for a group of professionally minded research students. Charles W. Eliot, late president of Harvard University, said: "The very best kind of education is obtained in doing things one's self under competent direction and with good guidance." There is more truth and significance in that statement than most educators have yet appreciated.

A graduate school of geography should have a full equipment for cartographical work. Instruments for enlarging and reducing maps, tracing, transferring, lettering, and colouring, should be at hand. A photographic department is needed where all ordinary work of development and printing can be done, where lantern slides and larger transparencies can be made, and where base maps can be reproduced conveniently. The map collections should include copies of all good maps that have ever been published, and the collections should be kept up-to-date. The map is the geographer's peculiar and special means for presenting his facts. Nothing can take the place of the map, and much greater use can be made of cartographical methods in pre-

senting geographical data than has yet been made. An indispensable department in the equipment of such an institution is the library. Full sets of the geographical periodicals of the various countries must be available. The selection and cataloguing of all works bearing upon geography, mineral resources, economics, and exploration must be carried out with great care. Census reports and all other statistical publications must be gathered. The geographical work-room calls for a special library which has been selected so as to provide as much as possible of the factual material for the investigator. An indispensable feature in such a work-room is a card-catalogue or index which simplifies the search for material bearing upon a problem. It is a fundamental rule that the investigator should first become familiar with all that is known on the problem under consideration before he attempts to make a contribution. It is of prime importance that those who contemplate field studies should be familiar with the maps and literature bearing upon that field before they leave the work-room.

In the conduct of the educational work of an institution established for the promotion of geographical studies plans should be made so that each student receives definite training in field methods as well as in indoor methods of research. No one should count himself a geographer who cannot enter the field and place upon the map the surface formations which are there present. He should be able to recognize and classify the topography of the region visited, the soils, the types of vegetation, and the types of land utilization. It is highly desirable for all geographers and absolutely essential for those who contemplate any exploratory work to be trained in the methods of making maps in the field. Even those who wish to keep a careful record on a reconnaissance journey should have the fundamentals of surveying included in their course of training. A good school of geography will therefore include in its curricula a certain amount of training in field methods. For those who expect to enter professionally upon educational work, there should be instruction on the selection, organization, and presentation of geography to students of various stages of advancement. Such instruction requires the services of an expert in education who is well acquainted with the supply of geographical knowledge available. There should be maintained in every School of Geography a special chair entitled Geography in Education.

All through the pre-historic periods of man on this earth and for at least 4000 years of recorded history the great ocean bodies served as barriers to travel and perhaps fortunately so. The British and the Japanese profited by their isolation on islands of the sea and developed

great internal power. Later with the conquest of the sea came the growth of the British and the Japanese Empires. Mountain ranges and desert regions also were great barriers, preventing easy communication between peoples. Thus the Chinese were restricted to a narrow coastal lowland, where they developed a wonderful civilization as yet but little known to the rest of the world. The plateau areas surrounded by high mountains such as Tibet, the home of the Lamas, and Peru, the land of the Incas, produced unique types of civilization. The high mountain regions of the Alps, the Himalayas, and the Caucasus have all led to the isolation of peoples. The smallest independent countries in the world to-day are in the mountains of Italy and northern Spain. There we find the tiny republics of San Marino and Andorra. The cold lands of the Eskimos and the dense jungles of the tropics where the Pygmies live have served as local habitats and led to the development of peculiar types of life. Isolation has been the rule not the exception throughout the world. Isolation brought about differences in languages, in social customs, and in religion. The feuds between highlanders and lowlanders have been told in story and sung by the poets.

China is struggling to overcome the influences of isolation. She is endeavouring within her own country to abolish sectional isolation, to develop national consciousness, and to overcome the handicaps due to long separation from the rest of the world. The eastern and western civilizations have met in the Orient, and adjustments are absolutely necessary. Japan first faced the problem about 75 years ago, when Commodore Perry called upon the Mikado and presented to the Japanese people a boat-load of the inventions of the western world. During the last 50 years, Japan has made remarkable progress in adjusting her ways so that she may compete in a world dominated by western civilization. All those who know the Chinese well and certainly all friends of China have confidence that in time the people of that country will solve the internal problems as well as the international problems that have come to them on account of the thousands of years during which they have lived in isolated groups within their country and of their isolation as a nation from the rest of the world. All through the last century, the people of the Near East have been undergoing an exceedingly difficult metamorphic process in their efforts to adjust their ways to the demands of western civilization. It is a record of wars and terrible massacres.

In the United States of America while passing through a period of rapid expansion westward the people lived more or less in isolation

from the rest of the world. During that time the American people were intensely interested in the development of new resources. They were engaged in a great adventure. New lands were being opened up, new plans for extensive agriculture with the help of machinery were being tried, great mineral wealth was being exploited, railroads were being built, and modern means of communication that have come with the development of science and technology were being developed. They were naturally self-centred. There is no doubt that there developed in the United States a strong nationalistic spirit. That was a period of isolation when many American citizens lost respect for the countries from which their forefathers came. That unfortunate condition is not entirely corrected. We find ample evidence in the actions of prominent officials within the United States of narrowness and provincialism due to ignorance of the other peoples of the world and their failure to respect those peoples. Their recent national action toward the people of Japan and China is a shameful commentary upon their intelligence. It is evidence of a gross degree of ignorance of the culture and charm of the oriental peoples. There is ample evidence of suspicion, due to ignorance, directing the thoughts of American people when they consider the actions of peoples in other lands.

There is but one great barrier remaining between the nations of the world to-day. That barrier is ignorance of each other. Man has conquered space and time. The great barrier of ignorance remains to be conquered. As the improved means of travel and communication have come, trade relations have developed between this country and most of the other countries of the world. It is but a commonplace to-day to call attention to the economic unity of the world. But there is much more than economic unity. Just as certainly as commodities of trade pass back and forth, so do ideas travel from one country to another; and we find represented in our own commonwealths the various political, social, and religious ideas of the other countries of the world. The days of isolation have passed, and the days for co-operation are at hand. We are living in an era when the problems of international relations are uppermost. We must prepare ourselves and the young people of the rising generation in each country to meet these problems. Isolation is impossible. Through the development of science and technology, the great physical barriers that lead to isolation have been removed. The people of this world are within speaking distance of each other. They are in fact elbow to elbow, and in some parts it is even difficult to find parking-space. Many economic, social, and political contacts have been established, and some already

realize that we are interdependent on each other. Intelligent sympathy must be based on a knowledge of the handicaps due to topography, soil, or climate, or due to location or the inheritance of ideals of life. The last remaining barrier, that of ignorance, which so often breeds suspicion, must be removed, and an intelligent sympathy must be cultivated.

These facts commonly known to geographers should be known to all people. It is the duty of geographers so to function through the educational systems in the different countries of the world, in the common schools, in the secondary schools and universities, that the fundamental significance of environmental factors is clearly understood by the great masses of people. Geography should always play a very important part in the educational work of a nation. No subject will function more forcefully or more appropriately in the economic development of a nation than geography. No subject has greater possibilities in establishing intelligent sympathy between the peoples of the world than geography. No subject, therefore, has the possibilities of contributing more to the establishment of good will among the peoples of the earth than geography. Professional institutions founded for the promotion of this field of study should, therefore, receive the encouragement and the endowments which will allow them to function in the several countries of the world so that through their co-operative work the people in each country may come to know the people of the other countries, to understand each other's problems, to appreciate the interdependence of peoples, the folly of the old custom of settling disputes by armed force, and the inestimable economic and cultural advantages of cordial co-operation among the inhabitants of this earth.

DR MARIE POLACZEK wished to express as a Pole her keen appreciation of Prof. Atwood's paper. Geography is certainly a study that stimulates the intellect by demanding precision, influences the character by travels and sojourns abroad thereby promoting the comprehension of other conditions and other nations, and by the story of geographical discovery puts youth in contact with the great explorers who are the heroes of modern times. She suggested that the International Geographical Union should facilitate the exchange of geographical syllabuses in order to arrive at the best course for all students from the novice at the primary school to the finished product of the university.

DR C. B. FAWCETT emphasized his agreement with the view that geography is essentially the study of man's adjustment to his environment on this earth; and necessarily therefore we hope that our studies will result in improving that adjustment. In this country he knew of only two Local Authorities that had appointed geographers as assistants in Town-Planning, a subject which we hope is but a beginning of one application of geography.

PROF. J. STANLEY GARDINER drew attention to the tendency of modern research to extend to two or more sciences and the difficulty of research workers in acquiring the proper training in and correlation between each of the sciences. This remark applied particularly to economic problems which embraced all sciences and could best be studied in a graduate school of geography such as Prof. Atwood had founded. Cambridge, in reconstructing its department 22 years ago, considered this matter, but the financial difficulties were insuperable; even to-day there is not a Professor of Geography, the University not having the necessary funds to meet his stipend. They had to begin in a small way with five or six lecturers; but for research they encouraged higher training in sciences and the taking of an honours degree in geography. They provided full education in cartographical, physical, regional, political, and economic geography; and they found by experience that their students were in demand for the higher departments of commerce, for services in the colonies, and for many other branches of practical life. They hoped more and more to develop their post-graduate side; but he feared that for 50 years not only Great Britain but all Europe would not have the means requisite to this end.

THE NATIONAL GEOGRAPHIC SOCIETY

COL. E. LESTER JONES

I have the honour to be the bearer of a message of cordial greetings and felicitations from the Trustees and Members of The National Geographic Society to the members and delegates of the International Geographical Congress and especially to the body of distinguished British scientists who are the hosts of this important convention.

May I take this occasion to present to my colleagues as briefly as possible something of the nature and work of the National Geographic Society, directed from its headquarters located in the nation's capital—Washington? The Society is organized on the democratic principle that each of its 1,200,000 members has an equal part in supporting its expeditions and its varied educational work; each of these members is equally entitled to know in a language he can understand the results of all its explorations, to be kept informed of the animated panorama of changing world geography, and to be supplied with all its maps, reports of its observers, and its world-wide photographic surveys. The Society has no endowments and receives no government subsidy; owing to the nature of our institution our geographical society must derive its financial support from its membership. Its interesting economic achievement is in growing in these circumstances to an institution which has actually become a part of the national life. It has interested these 1,200,000 people in the month-by-month narrative of vital geography during 40 years of active existence; it has distributed among them some 15,000,000 maps;

it has engaged their interest and financial support in a long series of scientific expeditions—this in spite of the fact that our country is not normally map-minded nor so vitally concerned in world changes as are the citizens of other world colonizing powers. You will understand that I am attempting to describe a unique achievement under unique conditions. I am not holding up a pattern because the pattern would have to be changed under other national conditions.

Dr Gilbert Grosvenor, president of the National Geographic Society, developed the instrumentalities by which all this is accomplished. The Society reaches its members through *The National Geographic Magazine* which he has edited for 29 years. He first saw the wide uses of the photograph in presenting and recording geography, not merely as an adjunct for illustrating geographical articles. He conceived that the general knowledge of geography is a concern of broad, general human interest, a part of the culture of the educated man, and not merely the closet science of the technically trained. The teaching of geography in our American public schools has been modified by his humanized, vivid mode of presentation.

This does not mean that the Society has neglected the technically scientific aspects of geography. In its 40 years it has accomplished notable explorations, discoveries, and research work, apart from developing the means of disseminating information both for the scientist and the layman. Its strictly scientific material is published in monographs for the specialists' use throughout the world. The Society has never lost sight of its double purpose, "the increase and diffusion of geographical knowledge." Preliminary to this "diffusion" comes the slow, painstaking, accurate, adventurous work of the explorer, the traveller, the technical observer, the trained photographer both in the air and upon the ground.

Two of the Society's explorations resulted in setting aside American natural wonder-areas as national reservations for the enjoyment of future generations—those of the Valley of Ten Thousand Smokes in Alaska and the Carlsbad Caverns in New Mexico. The Society supported the expeditions of Robert E. Peary including that which discovered the North Pole, and perfected the instrument, the sun compass, which Commander Byrd characterized as essential to his successful flight over the Pole. It has voted $25,000 from its research fund and supplied personnel towards his forthcoming Antarctic expedition. One series of explorations supported in equal part by the National Geographic Society revealed the most important early American ruins of South America at Machu Picchu; another sur-

veyed the most populous pre-Columbian region of North America at Chaco Canyon, New Mexico; a third explored the oldest known human habitation of either of the Americas near Mexico City.

The Society has pioneered in certain fields of geographical study, notably in volcanology, glacier observation, and research in earthquake areas. The Society's first exploration in Alaska in 1890 was under the leadership of an eminent geologist, Israel C. Russell. It discovered Mt Logan, Canada, and explored the regions of Mt St Elias with its colourful ribbon clouds and Mt Cook with its majestic peak. It also discovered and described many major glaciers of the region. Dr Russell noted the type of these ice patches not previously classified and gave them the name "Piedmont Glaciers." The Society's explorations in a region which is popularly known as "Seward's Ice Box," especially the finding of valleys of abundant flowering plants and ferns, aroused interest in the hitherto neglected possession which has since become a treasure house of national resources. The Society contributed financial aid and scientific guidance to the Wellman polar expedition. That which went out in 1898 collected in Franz Josef Land, hitherto unknown territory, data upon temperatures and atmospheric conditions which have been of high value to explorations. A technical representative was detailed by the Society to accompany the Ziegler polar expedition of 1903–1905 and to direct the scientific work. It was a technical commission convened by the Society that examined Peary's notes and observations, found them accurate, and vouched for his polar achievement. In 1925 the Society sent out an expedition in which Commander Richard E. Byrd gained his far-north flying experience. That expedition made the first aeroplane flight over northern Greenland and Ellesmere Island and accomplished an intensive study of bird, animal, and fish life and the flora of those regions. One of the naturalists brought back specimens of more than 1500 birds, some of unknown varieties, and others which are modified types of known birds. The expedition found breeding places and saw the juvenile plumage of birds whose life-history hitherto had been incomplete.

In its dissemination of geographical knowledge, *The National Geographic Magazine* was first in America to employ the natural-colour photograph, so valuable in reproducing the physical features, flora, native costumes, and other aspects where colour is essential to exact geographical knowledge. This expedition brought back the first colour photographs which were taken in the area it covered and also aeroplane pictures which afford valuable permanent records of the

terrain and life of the region. Data on temperature, flight velocity, and other flying factors were garnered by an aerographer, and the geodesist made magnetic and tidal observations.

The Society's researches in the field of seismology and volcanology began in 1902 following the eruptions in Martinique and St Vincent. The second expedition of which Dr Thomas A. Jaggar was a member was sent to study Mont Pelée and Soufrière. This subject was then virtually a virgin field, and the impetus then given to the study of volcanic action has been fruitful. For a quarter of a century since then Dr Jaggar has studied volcanic phenomena, and he now heads one of the Society's expeditions to explore the Mt Pavlof sector of the Alaskan Peninsula and the Aleutian Islands volcanic chain. He is making an intensive study of the longest battery of craters in the world and will compare the results with studies he has already made in Hawaii and those of Japanese scientists off the coast of Asia.

The most spectacular volcanic work of the Society was done after the eruption of Mt Katmai in Alaska in 1912. It was decided to send an expedition to that area which had been covered with deep deposits of volcanic ash. The primary purpose was the study of the rejuvenescence of the flora which had been obliterated. The party going to Mt Katmai saw that the eruption had left a crater almost as large as Vesuvius. Crossing the mountains toward Bering Sea they discovered that vast and impressive natural wonder, The Valley of Ten Thousand Smokes, a potential Yellowstone Park still too hot for the development of geysers. So many vistas opened up for scientific investigation that a series of four subsequent expeditions were sent out under Dr Robert F. Griggs, each with a corps of allied scientists who made intensive studies in their respective fields. The accounts of these explorations and various investigations were published by the Society in *The National Geographic Magazine*, and later were bound in a volume for the general reader; and four supplementary studies for technicians were published in the Society's monograph series of *Contributed Technical Papers*[1]. The Valley of Ten Thousand Smokes was conservatively named. There were estimated to be some ten million vents which emitted jets of superheated steam and other gases. They formed

[1] *The Valley of Ten Thousand Smokes* by Robert F. Griggs; 350 pp., 262 engravings and colour plates; 7 special maps. *The Origin and Mode of Emplacement of the Great Tuff Deposit of the Valley of Ten Thousand Smokes* by Clarence N. Fenner, petrologist, Geophysical Laboratory, Carnegie Institution. *A Chemical Study of the Fumaroles of the Katmai Region* by E. T. Allen and E. G. Zies, chemists, Geophysical Laboratory, Carnegie Institution. *The Fumarolic Incrustations in the Valley of Ten Thousand Smokes* by E. G. Zies. *The Coleoptera Collected by the Katmai Expeditions* by Edwin C. Van Dyke, University of California.

incrustations of beautiful colours which were recorded by colour photography.

The story of the human race of America before the coming of Columbus was long a sealed book. The expeditions of the last few decades show that aboriginal civilizations of our continent were highly developed. The Society's expeditions in Peru, Mexico, and in the State of New Mexico have opened some of the most fascinating chapters of this lost New World history. In 1912 the Society and Yale University undertook jointly a series of expeditions under the leadership of Hiram Bingham (now United States Senator from Connecticut). These expeditions revealed ancient highways and buried towns which indicated that Machu Picchu lay in one of the most densely populated regions of pre-Columbian America; that the Incas made pottery of high artistic worth; that trepanning of skulls was practised among them; and that their irrigation projects were more extensive than the hanging gardens of Babylon. They had learned to build retaining walls for their staircase farms, sometimes employing stones weighing tons; and they transported soil for many miles to make beds for their crops. The botanists of these expeditions found that this people had domesticated some 80 species of plants, among them the potato and Indian corn. The naturalist found vampire bats which had lost the power of swallowing solids through sucking the blood of animals. A general account of that expedition's work is contained in *Inca Land*, a volume by Dr Bingham; and more than 50 volumes and monographs bearing upon various phases of the expeditions are listed in the *Bibliography* accompanying that volume.

Seven expeditions of the Society to Chaco Canyon, New Mexico, unearthed and explored the remains of America's finest prehistoric communal dwellings. One of these pre-Columbian "apartments," Pueblo Bonito, is believed to have housed at least 1500 people. The expedition traced 350 rooms on the ground floor, excavated 32 kivas or ceremonial chambers, and found evidence that the building was four stories high and contained about 600 rooms. The Bonitans were Stone Age people. Yet they built canals to irrigate their arid lands, grew corn, beans, and squash, raised cotton, wove it into cloth, and made sandals from the fibre of the yucca plant. Primarily an agricultural people, they had a far-flung commerce. They imported macaws from Mexico, as skeletons remaining show; and shells from the Pacific also occur in the rooms. Excavations brought to light a mass of exquisite art objects and domestic utensils. Among the former was a turquoise necklace of 2500 pieces and four pendants, with each

bead as carefully matched as a string of pearls. Jet rings, with tiny carved turquoise bird mountings, vanity boxes, and clay rouge were found, as were specimens of basketry, instruments for removing flesh from skin, bone needles and pipes, the latter being used both for pleasure smoking and for making "clouds" in the ceremonial chambers. A subsequent study of Pueblo Bonito was carried on by the Society to determine, by a co-ordination of the cycles of tree growth as represented by the annual rings, the exact period when this area was the metropolis of the New World. That study is still in progress.

The Society's expeditions which have pushed farthest back into early American history were those sent to the ruins of Cuicuilco, the Pompeii of Mexico. South of Mexico City lies the Pedregal, a mass of unweathered lava from the volcano Xitli. Beneath the "Stony Place" is a blanket of soil, and underlying the soil is another lava flow of the remote past. In this second flow are incased remains of a life that flourished at a period variously estimated at from 3000 to 6000 years ago. Clay images, bone awls, ear ornaments, and other objects found in this treasure house of the earliest known American civilization are now on view, along with other exhibits of the Society's explorations, at its headquarters in Washington, D.C. In addition to the collection at its own headquarters, the Society has on view at the Smithsonian Institution at Washington an exhibit of hundreds of the objects recovered at Pueblo Bonito; and the natural history specimens brought back from its Arctic expedition enrich a number of universities and museums.

Following the location by Joseph F. Rock of the chaulmoogra tree in Burma, the oil of which is used in the treatment of leprosy, the Society voted him a grant for botanical explorations in Yunnan and Szechwan Provinces in China. Dr Rock sent back a blight-resisting chestnut tree which is being cultivated in the United States with the object of re-foresting the chestnut-blighted Eastern seaboard. Nearly a thousand kinds of rhododendrons were introduced, and he also brought back 1700 stuffed bird skins, 500 mammal specimens, and many thousands of plants. A study by the Government Department of Agriculture resulted in a number of these plants being introduced in the United States. Dr Rock traversed areas which had not been entered by Western observers since the times of Marco Polo. Another botanical and zoological expedition financed and sponsored by the Society spent two seasons in exploring the Province of Kweichow, China, and contiguous territory. This area has been almost as in-

accessible as Tibet. The expedition collected many botanical specimens, which were presented to the Smithsonian Institution, among the plants being a new species of violet, *Viola chingiana.*

Four years ago the Society commissioned a geologist to head an expedition which explored the Carlsbad Caverns in New Mexico. The expedition found the caverns to be among the finest in the world, both in the dimensions of their chambers and in the beauty of their formations. The publication of data about these caverns and accompanying photographs of the interior in *The National Geographic Magazine* resulted in President Coolidge setting aside the area for national use.

Believing that the solar radiation researches of the Smithsonian Institution held out the hope that the relationship between the solar constant and the weather may be discovered, the Society set up a solar observatory at Mount Brukkaros in South West Africa. Permit me to acknowledge at this time the cordial co-operation which the South African Government has extended to the Society's observers at their lonesome post in the midst of a Hottentot reservation. This station is under the direct auspices of the National Geographic Society and the Smithsonian Institution. It works with instruments that were especially invented for the expedition and uses basic figures for its computations which took many years to compile.

These are only a few high lights from the many years in which the National Geographic Society has carried on its explorations. From the nature of the Society's organization previously pointed out the support of these expeditions comes from the membership of the Society, numbering more than a million. These members are keenly interested in the progress of the expeditions they support, and thus the layman has become a true patron of scientific research. The Society's membership is now world wide; its magazine, its maps, and other publications go to members in every civilized nation, colony, and island which has a postal system. *The National Geographic Magazine* is more frequently bound into annual volumes than any other American periodical. Its files constitute a compendium of geographical information and illustration used in thousands of public libraries and school libraries throughout the United States. In a number of States of our country the magazine is required supplementary reading in the schools. Many of its numbers containing special articles have been adopted as texts by colleges. Because geography probably is the most useful of all sciences to the layman and the most interesting, the Society has made its geographical

information available in publication form through numerous channels. Some 600 newspapers, at their request, are sent daily bulletins from the Society on geographical subjects, and 35,000 school teachers obtain weekly for classroom use illustrated bulletins containing changes and data too recent to be found in textbooks.

The outstanding American award in the field of exploration is the Hubbard Gold Medal so far bestowed by the Society only upon eight distinguished explorers. These are Robert E. Peary, Roald Amundsen, Robert A. Bartlett, Grove Karl Gilbert, Sir Ernest Shackleton, Vilhjalmur Stefansson, Richard E. Byrd, and Charles A. Lindbergh. Special medals and life memberships have also been given for distinctive service in the field of geography.

The Society's photographic expeditions, in the skill of the photographers and their knowledge of the geographical conditions, deserve to rank with other types of scientific expeditions. These photographic surveys frequently make available new and comprehensive information about areas which have been but slightly explored and only crudely mapped. The Society's library of more than 200,000 unpublished photographs is a noteworthy reservoir of geographical information.

The cartographical department of the Society has compiled, supervised, and issued large wall-maps of the continents, and of various regions, such as the islands of the Caribbean, the Arctic, North and South America, Asia, Africa, post-war Europe, etc., etc., and is now publishing a series of State maps. It prepared a map of the world on a special projection which minimized distortion. All these maps went to the membership of more than a million along with *The National Geographic Magazine*. These maps are so made that they are usable by laymen, and they contain the most recent data available from new surveys of foreign governments and from field data of individual explorers.

The weekly lectures of the National Geographic Society during 40 winters have become an institution in the national capital. Since their inception more than 1200 explorers, world travellers, and statesmen have addressed the Society's Washington meetings. When these lectures are of general interest they are reprinted and illustrated in *The National Geographic Magazine* for the Society's entire membership.

Dr Gilbert Grosvenor is president of the National Geographic Society and editor of *The National Geographic Magazine*. Dr John Oliver La Gorce is vice-president and associate editor. Among its

distinguished Board of Trustees, of which I have the honour to be a member, are William Howard Taft, Chief Justice of the United States; Charles G. Dawes, Vice-President of the United States; John J. Pershing, General of the Armies of the United States; David Fairchild, in charge of Agricultural Explorations, U.S. Department of Agriculture; C. Hart Merriam, Biologist and Member of the National Academy of Sciences; C. M. Chester, Rear Admiral U.S. Navy; John Barton Payne, Chairman American Red Cross; A. W. Greely, Arctic Explorer, Major-General U.S. Army; George Otis Smith, Director U.S. Geological Survey; O. H. Tittmann, formerly Superintendent U.S. Coast and Geodetic Survey. The officers of the National Geographic Society feel that the Society has made a valuable contribution to American life in enrolling more than a million members in support of geography; their interest assures an ever widening scope for scientific work and increasing public appreciation of what technical scientists are doing for mankind's betterment.

GEN. PERTEV PASHA tendered to Col. Lester Jones his hearty thanks for giving in his very interesting lecture an opportunity of hearing about the National Geographic Society of the U.S.A. which had made possible so many expeditions and discoveries. He had personally received a copy of *The National Geographic Magazine* some months ago at Constantinople from an American gentleman who was a member of the Society; it was indeed a beautiful and wonderful magazine.

M. LE PROF. E. DE MARGERIE, qui a l'honneur de faire partie de la National Geographic Society depuis plus de trente ans, est heureux de l'occasion qui lui est offerte pour exprimer au Col. Lester Jones la gratitude de tous les lecteurs de *The National Geographic Magazine*. Le nombre et la qualité des magnifiques illustrations photographiques qui ornent chacun des numéros de cette Revue en font un véritable trésor aussi précieux par sa richesse documentaire que par son irréprochable exécution.

PRECISE LEVELLING ACROSS THE CENTRAL RANGE OF FORMOSA AND THE DETERMINATION OF THE ALTITUDE OF MOUNT NIITAKA

COL. E. ISHII

The Land Survey Department of Japan carried out precise levelling across the central range of Formosa in order to connect across the centre the precise levelling line round the coast. The work was done during the months May–October, 1924.

The district traversed belongs entirely to the uncultivated section of the island and extends from tropical forests to temperate forests. On the mountain summits snow reaches a depth of nearly 3 m. from

January to March. It is hardly possible to make the traverse by road; there are over a dozen suspension bridges constructed of wire. The topography of the eastern side of the range consists of especially steep slopes.

We used Zeiss precise level No. 3 and a levelling staff with invar band for this survey. In addition we measured the altitudes of twelve stations by barometric observations, using Fortin mercury barometers at 6 a.m. and 6 p.m. every day and comparing the results with those obtained by barometric observations at the meteorological observatory at Taityu at the same time. The altitudes by the barometric observations had a maximum difference of 25 m. from those by precise levelling.

As the altitude of Mt Niitaka (Mt Morrison), the highest mountain in Formosa, had been only roughly measured before, the Land Survey Department began precise levelling from July to September, 1924, starting from the benchmark near Kagi, proceeding a distance of about 15 km. with secondary levelling, and obtaining the altitude of the mountain by trigonometrical levelling. The altitude of Mt Niitaka thus obtained differs by nearly 12 m. from the former rough measurement and is found to be 3950 m., which is the greatest altitude hitherto surveyed in the Japanese Empire.

APPENDIX

HISTORICAL EXHIBITIONS

BRITISH MUSEUM, LONDON

EXHIBITION OF MAPS, PLANS, AND VIEWS

AN exhibition of manuscript and early engraved maps was arranged in the King's Library of the British Museum. On Monday, 16 July, at 11 a.m. Mr F. P. Sprent, in charge of the Map Department, described the exhibits to members of the Congress.

In the following list the items marked * were reproduced in *Six Early Printed Maps selected from those exhibited at the British Museum on the occasion of the International Geographical Congress* 1928, London, 1928 (6*s*.), and the items marked † in *Four Maps of Great Britain designed by Matthew Paris about* A.D. 1250 *reproduced from three manuscripts in the British Museum and one at Corpus Christi College, Cambridge*, London, 1928 (12*s*. 6*d*.).

See *Old Maps at the British Museum: Geographical Journal*, August, 1928, LXXII, pp. 187–8, and *Some Map Reproductions: ibid.* April, 1929, LXXIII, pp. 375–6.

PRINTED MAPS

Case I:

1. The World, as known to the Ancients. *Rome*, 1478.
   (From the first Rome edition of Ptolemy's *Geographia*.)
2. The World, as known to the Ancients. *Ulm*, 1482.
   (From the first German edition of Ptolemy's *Geographia*.)
3. The World, according to the theories of the Middle Ages. *Lübeck*, 1475.
   (From *Rudimentum Noviciorum*.)
4. Map of the World. [*Ingolstadt*], 1530.
   A rare map by Petrus Apianus; one of the earliest known maps on the single heart-shaped projection.
5. Map of the World. [*Venice?*], 1506.
   The earliest known printed map to show any part of America. Designed by Giovanni Matteo Contarini, and engraved by Francesco Roselli.

*6. Map of the World. [*London*], 1596.
   A curious and little-known map of the World, noteworthy on account of its unusual projection which was devised by John Blagrave, an Oxford mathematician.

Case II:

1. Map of the World. *London*, 1598.
   (From Vol. 1 of the second edition of Hakluyt's *Principal Navigations*.)
2. Map of the North Polar Regions. *London*, 1675.
   (From the *Atlas Maritimus* of John Seller.)

*3. Map of the Mogul Empire. *London*, 1619.
   The earliest English map of the Mogul territories. Drawn by William Baffin.

4. Map of the Kingdom of Congo. *London*, 1597.
   (From *A Report of the Kingdome of Congo*, by Filippo Pigafetta.)
   Engraved by William Rogers, one of the earliest English engravers.

Case II (continued):

5. Map of New Holland. *Paris*, 1663.
   (From Thevenot's *Relation de divers voyages curieux*, Vol. 1.)
6. Map of Russia and part of Central Asia. *Antwerp*, 1570.
   (From the *Theatrum Orbis Terrarum* of Abraham Ortelius.)
   By Anthony Jenkinson, agent of the Muscovy Company in Russia.

Case III:

1. Map of the World. [*Antwerp?* 1581?]
   Probably the earliest of the various maps which show Drake's route round the World.
2. Map of the World. [*Amsterdam?* 1590?]
   Showing Drake's route round the World.
   Engraved by Jodocus Hondius.
3. Map showing the West Indies. *London*, 1589.
   (From *A Summarie and true Discourse of Sir Frances Drakes West Indian voyage*.)
   Shows the route followed by Drake on his expedition to the West Indies in 1585–6.

*4. Map of New France. *London*, [1610].
   One of a set of three maps drawn by Gabriel Tatton and engraved by Benjamin Wright, between 1600 and 1616.

5. View of Niagara Falls. *Utrecht*, 1697.
   (From Louis Hennepin's *Nouvelle Découverte d'un très grand pays situé dans l'Amérique*.)
   Believed to be the earliest view of the Niagara Falls.
6. Map of Guiana. *Frankfort*, 1599.
   (From *Americæ pars VIII* of de Bry's *Voyages*.)
7. Map of the supposed North West Passage. *London*, 1578.
   (From *A True Discourse of the late voyages of discouerie...under the conduct of Martin Frobisher*.)
8. Map of North America, by Michael Lok. *London*, 1582.
   (From Hakluyt's *Divers Voyages touching the discoverie of America*.)

*9. Map of New England, Virginia, etc. *Amsterdam*, [1655?].
   A map of the early European settlements in North America. The inset presents one of the earliest views of New York, as it existed in about 1651.

Case IV:

1. Map of the British Isles. *Bologna*, [1477].
   (From the Bologna edition of Ptolemy's *Geographia*.)
   The first printed map of the British Isles.

*2. Map of the British Isles, by George Lily. *Rome*, 1546.
   Apart from the various editions of Ptolemy's Atlas this is believed to be the first printed map of the British Isles.

3. Map of England. *London*, 1579.
   (From Saxton's Atlas.)
4. Map of Dorset. *London*, 1579.
   (From Saxton's Atlas.)
5. Map of Middlesex. *London*, 1593.
   (From Norden's *Speculum Britanniae. The first parte*.)
   The first English map on which roads are marked.

6. Map of Surrey. [*London*, 1610.]
   A reissue of John Norden's map of Surrey, originally published in 1594. The engraving is by Charles Whitwell.
7. Map of the Beacons in Kent. *London*, 1596.
   (From William Lambarde's *Perambulation of Kent*.)
8. Map of Glamorgan. *London*, 1626.
   (From *The Abridgment of Camden's Britañia*.)
9. Map of Somerset. *London*, 1611.
   (From Speed's *Theatre of the Empire of Great Britaine*.)

Case IV (below):

1. Map of Lincolnshire. *Amsterdam*, 1645.
   (From Vol. IV of the *Atlas Novus* of Joannes Blaeu.)
2. Map of Norfolk. *Amsterdam*, 1646.
   (From Vol. IV of the *Novus Atlas* of Joannes Jansson.)
3. Map of the Counties of Aberdeen and Banff. *Amsterdam*, 1654.
   (From Vol. V of the *Atlas Novus* of Joannes Blaeu.)
4. Map of the Counties of Dublin and Louth. [*London*, 1683.]
   (From the *Hiberniae Delineatio* of Sir William Petty.)

Case V:

1. Plan of Bristol. By James Millerd. [*London*, 1671.]
2. Plan of Cambridge. By Richard Lyne. [*London*], 1574.
3. Plan of Oxford. By W. Hollar. [*London*], 1643.
4. Plan of Norwich. *London*, 1559.
   (From *The Cosmographical Glasse*, by William Cuningham.)
   This little plan has the distinction of being, as far as is known, the earliest printed plan of any English town.
5. Plan of Exeter. By John Hooker. Engraved by Remigius Hogenberg. [*London?*], 1587.
6. View of Jerusalem and the surrounding country. *Mainz*, 1486.
   (From the *Peregrinationes in Terram Sanctam* of Bernhard von Breydenbach.)
7. Plan of Philadelphia. By Thomas Holme. *London*, 1683.
   (From *A Letter from William Penn...to the Committee of the Free Society of Traders, etc.*)
8. View of the Cape of Good Hope. By J. H. Schneider. *Amsterdam*, 1778.
   One of a set of four rare views showing the Cape a few years before the first British occupation.
9. View of Buenos Aires. *Lisbon*, 1748.
   (From *Relaçaõ do Sitio, etc.* By Silvestre Ferreira da Sylva.)
10. View of New York. *Amsterdam*, 1651.
    (From *Beschrijvinghe van Virginia, Nieuw Nederlandt, etc.*)
    This is believed to be the first printed view of New York.
11. View of Venice. *Cologne*, 1572.
    (From the *Civitates Orbis Terrarum* of G. Braun and F. Hogenberg.)

Case V (below):

1. View of Rotterdam. By J. de Vou and R. de Hooghe. *Rotterdam*, 1694.
2. Plan of Edinburgh. *Amsterdam*, [1690].
   (From *Theatrum praecipuarum totius Europae urbium*.)

Case VI:

1. Plan of Elizabethan London. *London*, 1737.
   Vertue's reproduction of the plan by Ralph Agas [*c.* 1590].
2. Plan of London in the 18th century. By John Rocque. *London*, 1746.
3. Map of the Western Suburbs of London. *London*, 1746.
   (Part of John Rocque's *Exact Survey of the Citys of London and Westminster . . . and the country near ten miles round.*)
4. Views of London before and after the Great Fire. Engraved by W. Hollar. *London*, 1666.
5. View of London Bridge. *London*, 1724.
   (From *Several Prospects of the most noted Publick Buildings in and about the City of London.*)
6. Plan of Westminster. By John Norden. *London*, 1593.
   (From Norden's *Speculum Britanniae. The First parte.*)
7. View of part of Westminster. *London*, [1690].
   (From *A Book of the Prospects of the remarkable places in and about the City of London.*)

Case VII:

1. Map of Switzerland. *Strassburg*, 1513.
   (From the first Strassburg edition of Ptolemy's *Geographia.*)
2. Map of France. *Venice*, 1536.
   One of the earliest maps of France, apart from those in the various editions of Ptolemy's Atlas. By Giovanni Andrea di Vavassori.
3. Map of Iceland. *Antwerp*, 1590.
   (From the fourth supplement to the *Theatrum Orbis Terrarum* of Ortelius.)
4. Chart of the coasts of Hampshire and Sussex. [*London*], 1588.
   (From *The Mariners Mirrour.* By Anthony Ashley.)
5. Map of English Rivers. *London*, 1681.
   (From Andrew Yarranton's *England's Improvement by Sea and Land.*)
6. Chart of Northern Europe. *London*, 1671.
   (From *The English Pilot* by John Seller.)

Case VIII:

*1. Map of Central Europe. [*Nuremberg*, 1492?]
   This map, showing the chief roads to Rome, is probably the earliest printed map on which roads are marked. Three routes across the Alps are shown: the Semmering, the Brenner, and the Splügen.
2. Map of France. *Paris*, [1650?].
   An early map of the main post-routes of France in the mid-seventeenth century.
3. Map of the road from London to Portsmouth. *London*, 1675.
   (From Ogilby's *Britannia.*)
4. Map of the road from London to Holyhead. By Hermann Moll. *London*, [1718?].
5. Map of the road between Brentford and Bagshot. *London*, 1790.
   (From *Cary's Survey of the high roads from London to Hampton Court, etc.*)
6. Maps of Nottinghamshire and Oxfordshire. *London*, 1790.
   (From *Cary's Traveller's Companion.*)
7. View of London. *Amsterdam*, 1616.
   By Nicolaes Visscher, published by Jodocus Hondius. It gives a good picture of London as it was during Shakespeare's later years, and shows the Globe and Swan theatres and the Bear Garden in the foreground.

MANUSCRIPT MAPS

The Geography of Ptolemy, the famous Alexandrian astronomer and geographer, in *Greek*. The present MS. was written in the fourteenth or fifteenth century. The page exhibited shows the conception of India prevalent in the Mediterranean world of the 2nd century A.D. [Burney MS. 111, f. 102.]

The World, drawn about A.D. 1000. The MS. is believed to have belonged to Battle Abbey in the reign of Henry II. The East is at the top.
[Cott. MS. Tib. B. v, f. 56 b.]

The World, drawn about A.D. 1200, in a Psalter of that date. The East is at the top, Jerusalem in the centre, within a zone of winds, figures of inhabitants, etc.
[Add. MS. 28681, f. 9.]

†Great Britain, drawn about A.D. 1250, by Matthew Paris, a monk of St Albans.
[Cott. MS. Claud. D. VI, f. 12 b.]

†Map of Great Britain by Matthew Paris, monk of St Albans.
[Cott. MS. Julius D. VII, ff. 50–53.]

†Map of Great Britain, A.D. 1250–1259, with indications of a great high road from Dover through London and St Albans to Durham; by Matthew Paris, monk of St Albans.

On the opposite page is a representation of the author kneeling in adoration before the Virgin and Child. [Royal MS. 14. C. VII, f. 5 b.]

Portolano, executed at Venice, *circa* 1489; probably compiled from various cartographers by Beneditus Pesina. The map exhibited is that of Palestine, the East at the top. [Egerton MS. 73, f. 38.]

Isolario of "Henricus Martellus Germanus," written and illustrated in an Italian hand, *circa* 1490. Exhibited is a map of Crete. [Add. MS. 15760, f. 57.]

Portolano, executed about 1508. It is interesting as the earliest extant Italian Portolano showing the north-east coast of North America. Newfoundland (Terra de los Bachalaos) and Greenland (Terra de Lebrados) are indicated.
[Egerton MS. 2803, f. 8 b.]

Portolano, executed about 1540, probably by Battista Agnese, showing the Spanish conquests in the New World, the east coast of South America with the Straits of Magellan, the east coast of North America as far as Newfoundland (Terra de Bacalaos) and the continent of Africa. [Egerton MS. 2854, f. 5.]

Book of Hydrography, executed by "John Rotz" [Jehen Roze of Dieppe] for Henry VIII in 1542. It shows, among other maps, the coasts of America at that date. The map exhibited represents the east coast of South America with interesting drawings of the manners of the natives. The South is at the top.
[Royal MS. 20. E. IX, f. 28.]

Portolano, elaborately executed by Diego Homem in 1558, probably for Philip II of Spain, during the lifetime of Mary. It shows, among other maps, a chart of the World on a plane scale, with the arms of the respective sovereigns emblazoned on the various countries. [Add. MS. 5415 A, ff. 7 b, 8.]

Portolano, executed by Fernão Vãz Dourado about 1573: among other finely drawn and ornamented maps, it contains a chart of the coastlines of western Europe, northern part of Italy, and the north-west of Africa, with the arms of the respective sovereigns emblazoned on the various countries. [Add. MS. 31317, f. 14.]

Raleigh's Map of Guiana, 1595. The courses of the Amazon, Orinoco and "Gaira" [Magdalena] are depicted, together with the lake and city of Manoa or "Il Dorado." The map agrees closely with Raleigh's Report on his Voyage to Guiana in 1595; and, if not (as is probable) his actual *autograph*, was no doubt drawn from his instructions after his return. [Add. MS. 17940 A.]

UNIVERSITY LIBRARY, CAMBRIDGE

EXHIBITION OF OLD ATLASES

By kind permission of the Librarian there was an exhibition of selected atlases typical of the early stages of Cartography. This exhibition was arranged in the University Library, and was open to view by members of the Congress each day from 2–4 p.m., except Saturday and Sunday. The following is the list of atlases on view; a short memorandum accompanied each of the exhibits:

1. PTOLEMAEUS, Claudius (2nd century A.D.). Geographia universalis vetus et nova. Fo. *Basileae*, 1540.
2. PTOLEMAEUS, Claudius (2nd century A.D.). Geographicae enarrationis, libri octo. Fo. *Lugduni*, 1541.
3. PTOLEMAEUS, Claudius (2nd century A.D.). Geographiae libri octo. Fo. *Coloniae*, 1584.
4. ORTELIUS, Abraham (1527–98). Theatrum orbis terrarum. 2nd ed. Fo. *Antverpiae*, 1570.
5. ORTELIUS, Abraham (1527–98). Theatrum orbis terrarum. 2nd ed. [*Another issue.*] Fo. *Antverpiae*, 1570.
6. ORTELIUS, Abraham (1527–98). Theatrum orbis terrarum. Fo. [*Antwerp*, 1595?]
7. MERCATOR, Gerard (1512–94). Italiae, Sclavoniae, et Graeciae tabule geographice. Fo. *Duysburgi* [1589].
8. MERCATOR, Gerard (1512–94). Atlas sive cosmographicae meditationes de fabrica mundi et fabricati figura. Ed. 4 *a*. Fo. *Amsterodami*, 1616.
9. MERCATOR, Gerard (1512–94). Ed. 10. Fo. *Amsterodami*, 1631.
10. HAKLUYT, Richard (1552–1616). [Map to] The principal navigations, voyages, traffiques and discoveries of the English nation. Fo. *London*, 1598–1600.
11. SAXTON, Christopher (born 1542 or 4, died *c.* 1610?). [An Atlas of England and Wales.] Fo. *London*, 1579.
12. CELLARIUS, Daniel (born *c.* 1550). Speculum orbis terrarum. (By D. Cellarius and G. de Jode.) Fo. *Antverpiae*, 1578.
13. LE CLERC, Jean (*c.* 1550–1621). Théâtre géographique du royaume de France. Fo. *Paris*, 1621.
14. SPEED, John (1552?–1629). The Theatre of the Empire of Great Britaine. Fo. *London*, 1611.
15. WYTFLIET, Cornille. Descriptionis Ptolemaicae augmentum, sive Occidentis notitia brevi commentario illustrata. Fo. *Lovanii*, 1597.
16. BRAUN, Georg (born *c.* 1550). Civitates orbis terrarum (per G. Braun et F. Hogenbergium). Fo. *Coloniae*, 1577–88.
17. NORDEN, John (1548–1626). Speculum Britanniae. The first part: An historicall & chorographicall discription of Middlesex. (2 copies shown.) 4to. [*London*], 1593.
18. WAGHENAER, Lucas Janszon (born *c.* 1550). Speculum nauticum super navigatione maris occidentalis. Fo. *Lugduni Batavorum*, 1586.
19. SELLER, John (fl. 1670–1700). The English Pilot. Fo. *London*, 1671.
20. SELLER, John (fl. 1670–1700). Atlas maritimus, or a book of charts. Fo. *London*, 1670.

21. Blaeu, Joan (died 1673). Geographia, quae est Cosmographiae Blavianae. (Atlas maior.) 11 vols. Fo. *Amstelaedami*, 1665 (1662). (2 vols shown.)
22. Janssonius, Johannes. Nouvel Atlas, ou Théâtre du Monde. Fo. *Amstelodami*, 1649–57.
23. Sanson, Nicolas (1600–67). Cartes générales de toutes les parties du monde. Fo. *Paris*, 1658.
24. L'Isle, Guillaume de (1675–1726). Atlas nouveau, contenant toutes les parties du monde. Fo. *Amsterdam*, 1730.
25. Jaillot, Hubert Alexis (1640–1712). Atlas françois...par H. Jaillot (et N. Sanson). Fo. *Paris*, 1695.
26. Robert de Vaugondy, Didier (1723–86). Atlas universel, par Robert et Robert de Vaugondy. Fo. *Paris*, 1757.
27. Ogilby, John (1600–76). Britannia. Vol. 1. Fo. *London*, 1675.
28. Blome, Richard (died, 1705). Britannia. Fo. *London*, 1673.
29. Hollar, Wenceslaus (1607–77). The Kingdome of England and Principality of Wales exactly described. Fo. *London*, 1644.
30. Anville, Jean B. B. d' (1697–1728). Cartes géographiques. Fo. *Paris*, 1743–86.
31. Cary, John (1754–1835). Cary's New English Atlas; being a complete set of county maps. Fo. *London*, 1809.

GEOGRAPHICAL DEPARTMENT, CAMBRIDGE

SIR GEORGE FORDHAM'S EXHIBITION OF OLD MAPS

By the kindness of that eminent student of cartography, the late Sir George H. Fordham, there was an exhibition arranged by him of a selection of the old maps in his possession, specially arranged to illustrate the evolution of Cartography in the sixteenth, seventeenth, and eighteenth centuries. The exhibition was arranged in a room at the Geographical Department, Downing Place, on the same floor as Section D room. The following explanatory catalogue of the exhibits was distributed to members of the Congress:

EXPOSITION D'EXEMPLAIRES CHOISIS DE CARTES GÉOGRAPHIQUES

Pour illustrer le développement et le progrès de la cartographie anglaise jusqu'au milieu du dix-neuvième siècle

PRISES DANS LES COLLECTIONS PRIVÉES DE SIR GEORGE FORDHAM à Odsey

I. Première Période.

Seizième—dix-septième siècles. (Méridien des Açores, etc., jusqu'à 1676.)

1. Carte du Comté de Kent. *Carde of this Shyre*. Publiée en plusieurs impressions dont les dates et l'auteur sont inconnus. De la *Perambulation of Kent* de William Lambard, 1576 et 1596. Exemplaires sans et avec les routes. Une feuille.
2. Saxton (Christopher). Carte du Comté de Hertford, 1577 (réimpression de 1642). Une feuille.
3. Saxton (Christopher). Atlas de 35 cartes des Comtés de l'Angleterre et du Pays de Galles, datées entre 1574 et 1578, sans titre, 1579. Remanié par Philip Lea, 1699, avec l'adjonction de cartes additionnelles, et un titre.

4. SAXTON (Christopher). Carte de l'Angleterre et du Pays de Galles, *circa* 1584. 20 feuilles. Édition remaniée par Philip Lea, et affublée d'un nouveau titre, 1687. Photographies de divers détails décoratifs de ces deux impressions. (Note du méridien de Ste Marie des Açores.)

5. NORDEN (John). Carte du Comté d'Essex, 1594. Réproduction de 1840. Une feuille.

6. NORDEN (John). Carte du Comté de Surrey, 1594. Réproduction moderne. Une feuille.

7. SYMONSON (Philip). Carte du Comté de Kent, 1596. Photographie. Une feuille.

8. NORDEN (John). Carte du Comté de Hertford. Du *Speculi Britanniae Pars. The Description of Hartfordshire*, 1598. Réproduction, 1901. Une feuille.

9. KEER (Peter). Cartes des Comtés de Hertford, et de Northampton, etc. réduites des cartes de Christopher Saxton, en 1599. D'un épitome de la *Britannia* de William Camden, Amsterdam, 1617. Deux feuilles.

10. Cartes de l'Angleterre, et des Comtés de Gloucester, Somerset, Middlesex et Sussex, gravées par William Kip et William Hole, d'après les cartes originales de Saxton et Norden. Prises dans une édition in-folio de la *Britannia* de William Camden, 1607. Cinque feuilles.

11. SPEED (John). Carte du Comté de Hertford, 1610. Du *Theatre of the Empire of Great Britaine*, 1611. Une feuille.

12. BILL (John). Carte du Comté de Cambridge, etc. Prise dans un atlas: *The abridgment of Camden's Britannia*, 1626. Une feuille.

13. Carte du Comté de Hertford, avec une Table triangulaire des distances, d'après celles inventées par John Norden, *An Intended Guyde, For British Travailers*, 1625. De la *Direction for the English Traviller*, 1635. Une feuille.

14. Carte du Pays de Galles, avec une Table des distances, d'après John Norden. De la *Direction for the English Traviller*, édition de John Garrett, 1680. Une feuille.

15. HOLLAR (Wenceslaus). La carte de l'Angleterre et du Pays de Galles, connue sous le titre *The Quarter-Master's Map*, copiée sur la carte de Saxton de 1584, pour l'usage des commandeurs dans la guerre entre le Roi et le Parlement en Angleterre, 1644. Réimpression de John Rocque, 1752. Six feuilles[1].

16. HOLLAR (Wenceslaus). Carte du Comté de Middlesex, datée de 1667. D'un atlas: *England Exactly Described, circa* 1671. Une feuille.

17. Portrait de John Ogilby, cartographe, 1600–1676. Gravé en 1654.

18. OGILBY (John). Routes royales en bandes d'après l'arpentage d'Ogilby. De sa *Britannia*, 1675 et 1698. Deux feuilles.

19. GARDNER (Thomas). Routes royales en bandes. Réduction de celles d'Ogilby. Prises dans *A Pocket-Guide to the English Traveller*, 1719. Une feuille.

20. BLOME (Richard). Carte du Comté de Sussex, 1673. De Blome's *Britannia*, 1673.

[1] See "A Note on the 'Quartermaster's Map,' 1644," *Geographical Journal*, July 1927, LXX, pp. 50–52.

II. Deuxième Période.

Dix-septième—dix-huitième siècles. (Méridien de Londres, 1676–1794.)

21. SELLER (John). Carte du Comté de Hertford, 1676. Réimpression de 1733. Une feuille.

22. MORGAN (William). Carte du Comté d'Essex. Sans date, mais fin du 17me siècle. Réimpression de 1733. Une feuille.

23. MORDEN (Robert). Carte du Comté de Derby. D'une édition de la *Britannia* de William Camden, 1695. Une feuille.

24. SENEX (John) et autres. Carte d'Irlande, 1711. Édition de 1749. Une feuille.

25. SENEX (John). Cartes-Routières d'après John Ogilby: *An Actual Survey of all the Principal Roads of England and Wales*, 1742.

26. KITCHIN (Thomas). Carte du Comté de Hertford. D'un atlas intitulé *The Large English Atlas, circa* 1749. Une feuille.

27. ROCQUE (John). Atlas de cartes des Comtés de l'Angleterre et du Pays de Galles: *The Small British Atlas*, 1753.

28. ROCQUE (John). Carte de l'Angleterre et du Pays de Galles, *circa* 1670. Une feuille.

29. DURY (Andrew). Atlas: *A New General and Universal Atlas, circa* 1760.

30. SENEX (John). Cartes-Routières: *The Roads through England delineated*, d'après Ogilby, 1762.

31. ROCQUE (John). Carte du Comté de Surrey, 1762.

32. DURY (Andrew). Atlas: *Plans of the Principal Cities of Great Britain and Ireland*, 1764.

33. DURY (Andrew) and ANDREWS (John). Carte du Comté de Hertford, avec plans de la ville de Hertford et de la cité de St Albans, 1766. 12 feuilles.

34. BOWEN (Emanuel and Thomas). *Atlas Anglicanus, circa* 1767.

35. ELLIS (John). Atlas des Comtés de l'Angleterre et du Pays de Galles: *Ellis's English Atlas*, 1768.

36. TAYLOR (George) and SKINNER (Andrew). Cartes-Routières de l'Écosse: *Survey and Maps of the Roads of North Britain, or Scotland*, 1776.

37. BOWLES (Carington). Atlas d'Angleterre: *Bowles's New Medium English Atlas*, 1785.

38. CARY (John). Carte des Environs de Londres: *Cary's Actual Survey of the Country Fifteen miles round London*, 1786.

39. CARY (John). Carte de Londres: *Cary's New and Accurate Plan of London and Westminster, the Borough of Southwark and parts adjacent*, 1787. Éditions de 1797 et 1819.

40. CARY (John). Cartes des Comtés de l'Angleterre et du Pays de Galles: *Cary's New and Correct English Atlas*, 1787. Édition de 1818.

41. CARY (John). Cartes des Comtés de l'Angleterre et du Pays de Galles: *Cary's Traveller's Companion*, 1790. Édition de 1821.

42. TAYLOR (Alexander). Carte d'Irlande: *A New Map of Ireland*, 1793.

III. Troisième Période.

Dix-huitième—dix-neuvième siècles. (Méridien de Greenwich.)

43. Cary (John). Carte de l'Angleterre, etc.: *Cary's New Map of England and Wales with Part of Scotland*, 1794. 81 feuilles.

44. Armstrong (Mostyn John). Atlas d'Écosse: *A Scotch Atlas*, 1794.

45. Davis (Richard). Carte du Comté d'Oxford, avec Plan de la Cité d'Oxford: *A New Map of the County of Oxford*. Gravée par John Cary, 1797. 16 feuilles.

46. Paterson (Daniel). Environs de Londres: *Paterson's Twenty Four Miles round London*, 1797. Une feuille.

47. Scale (Bernard). Atlas d'Irlande: *An Hibernian Atlas*, 1798.

48. Arrowsmith (Aaron). Carte des Indes, 1804. Six feuilles.

49. Smith (Charles). Atlas des Comtés de l'Angleterre et du Pays de Galles: *Smith's New English Atlas*, 1804.

50. Faden (William). Carte de France: *A Correct Map of France*, 1806. Quatre feuilles.

51. Cary (John). Atlas universel: *Cary's New Universal Atlas*, 1808.

52. Cary (John). Atlas des Comtés de l'Angleterre et du Pays de Galles: *Cary's New English Atlas*. Titre, 1809, et Cartes du Bedfordshire (1801) et du Buckinghamshire (1801), 1809.

53. Cary (John, junior). Carte de la Russie: *A Map of the Russian Dominions in Europe, with the adjacent Countries*, 1814. Neuf feuilles.

54. Cary (John). Carte des Iles Britanniques: *Cary's New Map of the British Isles*, 1815.

55. Greenwood (C.). Carte du Comté d'York, 1817. Neuf feuilles.

56. Mogg (Edward). Cartes-Routières de l'Angleterre et du Pays de Galles: *A Survey of the High Roads of England and Wales*, Vol. 1, 1817.

57. Cary (John). Carte de l'Angleterre et du Pays de Galles: *Cary's Six Sheet Map of England and Wales, with part of Scotland*, 1818. Six feuilles.

58. Langley (Edward). Atlas de l'Angleterre: *Langley's New County Atlas of England and Wales*, 1818.

59. Cary (John). Carte-Routière de l'Angleterre et du Pays de Galles: *A New Map of England and Wales* (*Cary's New Itinerary*, 9me édition), 1821.

60. Bryant (A.). Carte du Comté de Hertford, 1822.

61. Gardner (W. R.). Carte de l'Angleterre et du Pays de Galles: *New and Improved Map of England and Wales, including the Principal part of Scotland*, 1823.

62. Smith (Charles). Carte de France: *A Physical and Topographical Map of France*, 1824.

63. Pigot and Co. Atlas des Comtés de l'Angleterre, 1825.

64. Cary (John). Carte des Pays-Bas: *A New Map of the United Netherlands*, 1826.

65. Cary (George and John). Carte des Indes: *Hindostan*, 1824, corrigée à 1829. Six feuilles.

66. Hennet (G.). Carte du Comté de Lancaster (Henry Teesdale and Co.), 1830.

67. CRUCHLEY (George Frederick). Carte des Environs de Londres, 1830.

68. CARY (George and John). Atlas de l'Angleterre et du Pays de Galles: *Cary's Improved Map of England and Wales, with a considerable portion of Scotland*, 1832. 65 feuilles.

69. CARY (George and John). Feuille no. 27 (3 juin 1823) de *Cary's Improved Map of England and Wales* [1832]. Une feuille.

70. CARY (John). Carte d'Irlande: *Cary's New Map of Ireland*, 1832.

71. GREENWOOD (C. and J.). Carte de Comté de Cambridge, prise dans l'Atlas: *Atlas of the Counties of England*, 1834. Une feuille.

72. GREENWOOD (C. and J.). Atlas des Comtés de l'Angleterre, 1834.

73. WYLD (James). Carte des Environs de Londres: *A New Topographical Map of the Country in the Vicinity of London*, 1836. Une feuille.

74. Carte des Chemins de Fer dans le centre de l'Angleterre: *Map of the Manchester and Birmingham Railway, etc.* sans date, *circa* 1836.

75. LEWIS (Samuel and Co.). Carte de Londres et ses Environs: *A Plan of London and its Environs*, sans date, *circa* 1839.

76. LEWIS (Samuel and Co.). Carte de l'Écosse, sans date, *circa* 1839.

77. TEESDALE (Henry and Co.). Atlas Britannique: *New British Atlas*, 1840.

78. CRUCHLEY (George Frederick). Carte de Londres et ses Environs: *Cruchley's New Map of London and its Environs*, 1847.

79. FADEN (William). Premières feuilles de la Carte de l'État-major Britannique (*Ordnance Survey*), Comté de Kent, publiées par William Faden et datées le premier jour du dix-neuvième siècle, le 1er janvier 1801. Quatre feuilles.

80. *Ordnance Survey*. Carte de la triangulation des Iles Britanniques, 1909.

ROYAL GEOGRAPHICAL SOCIETY, LONDON

EXHIBITION OF OLD BOOKS, MAPS, ETC.

The following were the more important exhibits at the Society's House during the Congress:

BOOKS

1. LUDOLPHUS A SUCHEM. De Terra Sancta. Sm. 4to. [*Gouda*, 1484.]
2. SACROBOSCO. [John Holywood.] Sphericum Opusculum, etc. Sm. 4to. *Venice*, 1485.
3. ZAMBERTO, Bartolomeo. Isolario. 4to. *Venice, c.* 1485. [Account of the Aegean Islands.]
4. LILIUS, Zacharias. Orbis Breviarium. 4to. *Venice, c.* 1495.
5. MONTALBODDO, Fracan de. Paesi Novamente retrovati. 4to. *Vicenza*, 1507. [The earliest printed collection of voyages.]
6. MUNSTER, S. Cosmographia. Fo. *Basel*, 1550.
7. EDEN, R. and WILLES, R. The History of Travayle.... 8vo. 1577. [The first English collection of Travels.]
8. HAKLUYT, Richard. Principall Navigations...of the English Nation. 3 vols. Fo. 1599–1600.
9. DRAKE, Sir Francis. Sir Francis Drake revived. Sm. 4to. 2nd ed. 1652–3. [With portrait.]

10. FOXE, Luke. North-West Fox. Sm. 4to. 1635. [With the rare map of the Arctic Regions.]

11. SMITH, Capt. John. General History of Virginia. Fo. 1624.

12. SHERLEY, Sir A. Travels into Persia. Sm. 4to. 1613.

13. HENNEPIN, L. New Discovery of a Vast Country in America. Sm. 8vo. 1599. [With view of Niagara, picture of the Bison, etc.]

14. STÖFFLER, J. Elucidatio fabricae ususque Astrolabii. Fo. *Oppenheim*, 1513.

15. APIANUS, Petrus and GEMMA FRISIUS. Cosmographia, etc. 4to. *Paris*, 1551. [With heart-shaped World-map.]

16. CUNINGHAM, W. The Cosmographical Glasse. Fo. 1559.

17. DIGGES, L. Pantometria. 4to. 1571.

18. [GARCIE, P.] The Rutter of the Sea. Transl. by R. Copland. Sm. 8vo. 1560?

19. BORNE, W. A regiment for the Sea, etc. 4to. 1596.

20. BLUNDEVILLE, Thomas. His Exercises. 4to. 4th ed. 1613.

21. LAMBARDE, William. A Perambulation of Kent. 1st ed. 1576. [With the unique first issue of a rare map of Kent, perhaps made for this book.]

MAPS, ETC.

22. BERLINGHIERI, F. Geographia. 2nd issue. Fo. [*Florence*, *c.* 1500?] [Metrical version of Ptolemy's Geography, with some modern maps.]

23. [LAFRERI, A. and others.] Tavole Moderne di Geografia. Fo. *Rome*, *c.* 1574.

24. FURLANI, P. (after Gastaldi). Small silver globe. *Venice*, late 16th cent.? [Lent by Mr R. S. Whipple.]

25. MERCATOR, Gerhard. Unique single sheet of wood-cut edition of great World-map of 1569. *Antwerp*, *c.* 1579.

26. HONDIUS[1], Jodocus. Large World-map on Mercator's projection. *Amsterdam*, 1608.

27. BLAEU, Joan. Large World-map in hemispheres. *Amsterdam*, *c.* 1660.

28. HONDIUS, Jodocus. Typus Totius Orbis Terrarum. *Amsterdam*, 1595. [Known as the Christian Knight Map, from the representation of his fight against Sin, the World, the Flesh, the Devil, and Death.]

29. HONDIUS, Jodocus. One Sheet of unique 4-sheet Map of France. *Amsterdam*, *c.* 1600.

30. NORDEN, John. Maps of Surrey and Sussex, 1594 and 1595. [The only known copies of these first issues.]

31. SYMONSON, Philip. Map of Kent, 1596. [On a larger scale than other county maps of the period, showing the roads.]

Also various editions of Ptolemy's Geography and Atlases of Ortelius, Mercator, Saxton, Speed, etc.

[1] See *Reproductions of Early Engraved Maps*, No. 1, in 25 sheets with index sheet, with a *Memoir* by Edward Heawood, M.A., 24 pp. *Royal Geographical Society*, London, 1927. (63*s.*)

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** signifies the title of an address or communication*

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